SCIENCE.

FRIDAY, NOVEMBER 7, 1884.

COMMENT AND CRITICISM.

The treasury officials have partially reversed the obnoxious rulings by which recently they compelled public institutions to pay duty, or incur more onerous burdens still, in order to get through the custom-house the publications which congress had said they should have free of such charge. Their last circular is almost insulting in pointedly prescribing the business-agents of such institutions as persons whose oaths they will not take. The government of these bodies, situated often at such a distance from ports of entry that they cannot conveniently attend to the business details of importation, appoint agents, whom they trust, and who, from experience, can serve the institutions better than they can serve themselves. These institutions are now practically told by the treasury officials that the oaths of such appointees are not good enough for them, and that, to get the privileges which congress has awarded to these institutions in the interests of learning and progress, the governing bodies of them must be subjected to such impertinent discipline as it pleases the treasury officials to impose. They are plainly told that they may accredit all the agents they please, but the oaths of such agents cannot be taken. An oath, then, is not an oath, except as the treasury may approve the giver of it. This body of men who are thus traduced by the government are the importing book-dealers of the country.

The recent conference at St. Louis, of representatives from nearly all of the existing state boards of health, and their decision to meet at Washington in December, bring prominently forward the question of a national authority in health matters. The present National board of health was organized in April, 1879, under an act passed at the close of the forty-fifth congress. The board consists of seven members appointed by the president, one medical officer of army, navy, and marine hospital service respectively, and one officer from the department of justice. In the early days of the board it was called upon to deal with a very serious outbreak of yellow-fever in Memphis and other localities. The measures adopted at this time had an undoubted influence in the suppression of these outbreaks. In addition to this work, numerous investigations into causes of epidemic diseases and sanitary survey were made, the published results of which have become too well known to need recital here. While doing a most useful work, the moderate appropriation at the service of the board attracted the hostile criticism of certain members of congress, who succeeded in procuring legislation that limited the fund at the disposal of the board to twenty-five thousand dollars, with the proviso that their duties and investigations should be limited to the diseases cholera, yellow-fever, and small-pox. The next congress made no appropriation whatever for the board, and it is practically dead.

Having in mind the valuable services rendered by this organization, it is not easy, at first sight, to perceive the causes of its overthrow. These were, first, the department of the treasury, which asserts a claim to the disbursement of all funds appropriated by congress for the suppression of epidemic diseases, and to the selection of a medical officer of its own as agent in these operations; second, the active hostility of the State board of health of Louisiana, and the jealousy of some of the great commercial communities in regard to all quarantine restrictions; last, the composition of the board itself. As above stated, this consists of seven members at large, representing but seven of the thirty-eight states, — possibly the most important, perhaps the smallest, in the Union. Pennsylvania and Ohio have not been represented on

the board. While it has thus far apparently been composed of men of the best character and of high scientific attainments, there is no certainty, possibly but little probability, that the same standard can be maintained in the future. Any renewal of appropriations, or increase of powers, would be likely to make the board attractive to the place hunter.

Coming at this time, the St. Louis conference has an unusual significance. This voluntary assembly of representatives of the only public bodies possessing any real power to deal with epidemic disease, or questions of public health, might very easily be transformed into a national organization, certain to control, within the above limits, public opinion. Let the central authority be composed of delegates selected by state boards of health, when such boards exist; when there are none, by the governors of the respective states. Such a body may be convened at any time, in case of need: ordinarily, one or two sessions annually would be sufficient. An executive committee of moderate size, with permanent officers at Washington, could attend to such routine work as congress might see fit to intrust the board with. It is not advisable to burden a board of health with great patronage or much executive power. It should be largely devoted to scientific investigation of epidemic disease. These must, of necessity, be conducted on a scale so extensive that no private laboratory, public institution, or state board of health, has been or will be able to undertake them. The fact that the members of this association would be also members of powerful state organizations, would secure the co-operation of the various states, and would legitimately control, in a high degree, congressional action, and, as a board of consultation, would, when applied to, speak with an influence that no department at Washington could afford to neglect.

The secretaries of war and of the navy have indirectly raised what may prove a troublesome question respecting the duties of members of the National academy of sciences, who are also officers of the government. Our readers may remember, that, when the organization of the surveys was reported upon by the academy some years ago, a very strong protest against its conclusions was made by the chief of engineers, in which one of the strongest points was, that the men who conducted such surveys were not represented upon the committee which made the report. When a question very similar was submitted to the academy last summer, in order to elicit a report upon the coast and geological surveys, the signal-office, and the hydrographic office, the policy was adopted of putting an officer of the army, and one of the navy, upon the committee. When this fact became known to the heads of the departments, they decided that no officer of the government should take a place which might require him to report upon the policy of his chief; and both members, therefore, withdrew from the committee.

Without discussing the application of this principle in the present case, we hope it will in the future be so limited and defined as not to cripple the academy in cases where it might happen that there are no experts available except those who are officially connected with the government. During a state of war the most important questions submitted to the academy would probably pertain to instruments and appliances to be used in warfare, and it would clearly be impossible to omit from its committees the very men who knew most about the subject-matter submitted. The academy is, we believe, the only government organization now existing, or which ever has existed, the members of which were required to give their services to the government without charge whenever called upon. As such, the body would seem entitled to a large measure of consideration on the part of the government, which will be increased when we call to mind the value and importance of its reports. No amount of labor and research has been spared in cases when methods of defrauding the revenue by the chemical manipulation of products had to be looked into. The efficiency which

has characterized the workings of the present geological survey affords an example of the practical value of the academy's advice which should not be overlooked. While there may be one or two instances in which the opinions of the experts have not been justified by the results, we believe that the proportion of failure to success will, on critical examination, turn out to be less than in any other class of questions which the government has had to decide. The only reward received by the men who render these services is that of public appreciation. The damage which would be done by any act of the government, depriving the workers of this little reward, is a serious matter, and becomes all the more serious when we reflect, that, at more than one period in the history of the academy, the question whether it should continue its government existence hung in the balance.

LETTERS TO THE EDITOR.

The recognition, by marine animals, of the hour of the day.

THE changes produced by the tides are apparently much more important to marine animals than those which are due to the rotation of the earth; and the fact that many important physiological changes are regulated according to the hour of the day in these organisms, as well as in terrestrial animals and plants, is worthy of notice.

The phenomenon has almost escaped the notice of naturalists, although it is not at all unusual.

Claus in 1882, and Merejkowsky in 1883, have shown that the very young stages of Aequora and Obelia are found only in the morning; and Merejkowsky says that the successive steps in the formation of the planula of Obelia follow each other with such perfect regularity that each stage is met only at a definite hour in the morning. This author believes that the regularity is directly due to the action of light, but he gives no proof of this; and observations which have been made in the past three or four years at Beaufort, N.C., seem to show that the regularity is not due to external influences at all, but is determined within the organism, like the returning appetite which tells us that the dinner-hour has come.

The following are some of the instances which we have observed at Beaufort:—

Dr. E. R. Wilson finds that the eggs of Renilla, an Alcyonarian which lives upon the bottom below low-tide mark, are always laid at very nearly the same hour of the day; viz., 6 A.M. In a single case spawning took place at 5.30, and it was never observed later than 7 A.M.

The regularity appears to be independent of temperature, for the hour of spawning was the same in cold and warm days, although the temperature does have a very important influence on the rate of development of the embryo.

Dr. Wilson has observed a similar regularity in the spawning of Leptogorgia; and in this case, if I remember correctly, the hour was 4 A.M.

While Obelia lays its eggs early in the morning, I find that closely related Beaufort medusae spawn at night. Thus, Entima, Eirene, Turritopus, and Liriope discharge most of their eggs about 8 P.M., although captive specimens drop a few eggs irregularly at all hours. As one hydromedusa lays its eggs early in the morning, while another species lays them early in the evening, the regulating influence can hardly be the change of illumination. While studying the development of Lucifer, a pelagic crustacean, I found that sexual union occurs with great regularity between 6 and 8 P.M., while the eggs are laid between 8 and 10 P.M.; so that the early stages can be studied only between 10 P.M. and 7 A.M.

Dr. H. H. Donaldson has observed at Beaufort, that actinias of various genera are fully expanded only between 5 and 6 P.M. This is true of these animals in their natural homes, as well as in aquaria; and experiment showed that specimens which were kept in darkness expanded as promptly at the proper hour as those which were exposed to direct sunlight.

Among the animals which I have enumerated are some which live at the surface, as Entima and Obelia; some which live near low-tide mark, as the actinias; and some which live in deeper water, as Renilla. Some of them, as Lucifer, are vigorous swimmers, while some, as Gorgonia, are fixed.

Wilson's observations show that the regularity is not due to temperature, and Donaldson's experiments show that it is not the effect of light.

There is no evidence that it is due in any way to the direct influence of surrounding conditions, and I think we must believe that it has been established in each species by natural selection, on account of its advantage to the organism.

The phenomenon is especially important to the embryologist, for the failure to procure the fertilized eggs of any animal may be due to the fact that it is not captured or observed at the right hour of the day. It also shows the importance of marine observations when the naturalist may be on duty at all hours of the day and night. W. K. BROOKS.

The star-nosed mole amphibious.

It is now more than fifteen years since Dr. Gilpin announced that the star-nosed mole (Condylura cristata) had been seen swimming, in winter, in Nova Scotia; and his record, so far as I am aware, remains unique.

Mr. Napoleon A. Comeau, who lives on the north shore of the St. Lawrence, near the point where the river widens into the gulf, has recently been fortunate enough to witness the habit in question. He writes: "On the 30th of April, 1884, I saw a star-nosed mole swimming under water like a muskrat. It swam directly across a small brook, keeping near the bottom, and moving very fast. The brook was about six feet wide and two feet deep. As the mole approached the bank, it turned up its snout, so that I plainly saw the 'star' on its nose, and took refuge under some branches where I could not get at it. Snow was still deep along the banks of the stream, and there was plenty of ice in places, though the mole crossed in an open space."

I have more than once caught this species in galleries that were half full of water, and have always found it most abundant in swampy situations along the borders of streams, but I never had the good fortune to see it swim. C. HART MERRIAM.

SIR WILLIAM THOMSON.

Sir William Thomson's presence in this country, the prominent part he has taken in the two great scientific meetings held in America this year, and his course of lectures at the Johns Hopkins university, which has been attended by professors and students of physics from all parts of the country, will make a brief sketch of the man and of his work especially welcome at this time.

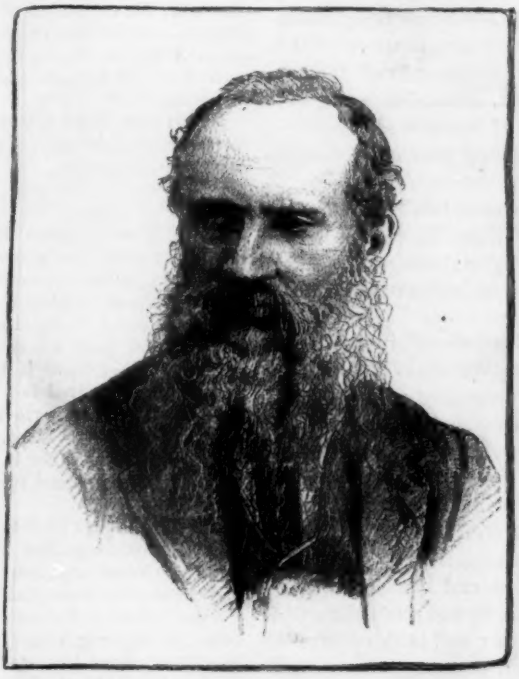
Born at Belfast in 1824, he showed at a very early age that the remarkable mathematical talent possessed by his father was to reappear in him with at least equal intensity. At the University of Glasgow, where his father held the chair of mathematics, he was, at the age of eleven or twelve, already noted among his much older classmates for his ability and originality. At the age of seventeen he began the splendid series of contributions to mathematical physics which have formed so great a factor in the progress of physical science. These first papers, written at so early an age, were of a nature to require a profound knowledge of both mathematics and physics; the first being a defence of Fourier's mathematical methods against some objections which had been made to them, and the second relating to the mathematical theory of heat and of electricity.

A mere glance at the list of Sir William Thomson's papers, as given in the Royal society's catalogue, serves to convey some idea of the diversity of mathematical and physical subjects upon which he has written. Running down the list in chronological order, and noting only here and there a title, we find him discussing the equations of motion of heat, the lines of curvature of surfaces of the second order, electric images, terrestrial magnetism, the theory of partial differential equations, the economy of heating or cooling buildings by currents of air, the dynamical theory of heat, the dissipation of energy, the density of the luminiferous ether, the theory of elasticity, the calculation of a certain class of definite integrals, the interior melting of ice, Leverrier's investigations on the motion of Mercury, the protection of vegetation from destructive cold at night, vortex atoms, — but we must make an end somewhere.

It is, of course, needless to say to the readers of this journal that it is not upon the number or diversity of his contributions to science that Sir William Thomson's fame and pre-eminence rest, but upon the fundamental importance and epoch-making character of some of those contributions. The article upon Sir William Thomson in the Scientific worthies series (*Nature*, 1876) gives a brief summary of some of his most important researches and inventions. We can here do hardly more than allude to a few of them, referring readers, for a fuller account, to the above article, from which we freely draw. Probably his most important contributions to mathematical physics have been his researches in electrostatics and magnetism. His first paper in this department of physics, on the elementary laws of statical electricity, written at the age of twenty-one, demonstrated that results which had previously been accepted were erroneous through a failure to adopt necessary precautions in the experiments upon which those results were based. In this paper he also began the work of founding the mathematical theory of electricity upon Faraday's theory of electrical induction, — a work which his later papers completed. In this field, as in many others, his work was not confined to mathematical, nor even to mathematical and experimental research: an almost equally notable part of it was the invention of most important and ingenious electrometric instruments, which have constituted the chief means of establishing our present system of practical electrometry.

His contributions to thermodynamics have also been of the highest and most fundamental importance. He was among the first physicists to thoroughly appreciate the effect, upon the theory of heat, of Joule's determination of the mechanical equivalent of heat; and, in the series of memoirs which he wrote upon thermodynamics, he placed the science thoroughly upon the new scientific basis of the doctrine

of heat as a mode of motion. He was the first to propose the use of an absolute thermodynamic scale for the measurement of temperature; and, in his paper on the electrodynamic qualities of metals, he presented his discovery of the electrical convection of heat, and of a great number of important relations between thermal and electric properties of matter. Perhaps the most striking of the results to which his studies in thermodynamics led him was the theory of the dissipation of energy.



The almost random list of papers which we gave above was designed to illustrate the variety, rather than the importance, of Sir William Thomson's work; but it is hardly necessary to say that many of his researches on subjects very wide apart have been profound and important. His great investigations on the subject of vortex motion, to which he has devoted much attention for so many years, his researches on the tides, his contributions to hydrodynamics, his researches on the physical condition of the earth, have all been of signal importance; and the highly original method of attacking the problem of the wave-theory of light, of which he gave some account in his recent Johns-Hopkins lectures, has long been occupying his mind, and may fairly be expected to give rise, in the not very distant future, to results rivalling in value any of his former discoveries.

Besides his contributions to the advancement of pure science, Sir William Thomson has been the originator of improvements and inventions of the highest immediate practical utility. The most prominent of his services of this character have been those connected with submarine telegraphy. Space does not permit our entering into details: but it may be mentioned, that he discovered the law of the 'retardation of signals,' which was the chief preliminary difficulty to be faced by those considering the feasibility of using a cable stretching under the ocean, from the old to the new world; that, to meet this difficulty, he invented the 'mirror galvanometer,' which, when the cable of 1858 came to be laid, was employed during the brief period of its successful operation; and that, when this cable broke, on account of difficulties and imperfections connected with its submersion, he devoted himself with signal success to improving the construction of cables, and the mechanical arrangements for their submersion.

The very great benefits conferred upon the world by the labors of Thomson and others, who contributed to overcoming the difficulties which were so triumphantly surmounted in 1866, were recognized by the bestowal upon them of the honor of knighthood. Other important improvements in telegraphy are due to him, but we must omit mention of them.

Two important improvements in navigation are also due to Sir William Thomson, — his improved mariner's compass, which has been adopted, we believe, by the British and French navies, and which is extensively in use upon large vessels generally; and his more recent invention of a navigational sounding-machine — navigational, as distinguished from the deep-sea sounding apparatus devised by him for purposes of research. The navigational sounding-machine permits of soundings being taken at intervals of a few minutes, in water of the depth of a hundred fathoms; and thus it gives navigators — who, it is to be hoped, will soon avail themselves of this new safeguard — the means of easily getting warning of danger long before it is imminent.

We cannot conclude even this brief and imperfect sketch of Sir William Thomson's work, without mention of the great treatise on natural philosophy upon which he and Professor Tait have united their labors.

To those who have had the privilege of personal contact with Sir William Thomson, his name will always be associated with the idea of personal lovableness and kindness, gentleness and modesty, even more than with that of scientific greatness. Every one who attended his recent lectures must have been deeply impressed with the truth of Helmholtz's remark, that "the gift to translate real facts into mathematical equations, and *vice versa*, is by far more rare than that to find the solution of a mathematical problem; and in this direction Sir William Thomson is most eminent and original." But he could hardly fail to be as strongly impressed with his possession, in an equally rare degree, of genuine and unaffected modesty, enthusiastic appreciation of the achievements of others, and tender consideration for all those whom the chances of time bring into connection with him, whether it be for a lifetime of friendship, or for a few fleeting weeks of union as teacher and pupil.

The accompanying portrait is after a crayon from a photograph taken in Montreal during the recent meeting of the British association.

THE NEW VOLCANO OF THE BERING SEA.[1]

Since the appearance in *Science* (vol. iii., No. 51, pp. 89–93) of Professor Dall's paper upon this new volcano, Lieut. G. M. Stoney, U.S.N., has embodied in an official report the results of a personal examination of this locality. It will be recalled that when Professor Dall surveyed the island of Ioanna Bogoslova (St. John the theologian) in 1873, seventy-seven years after its appearance by violent upheaval, he found, that with the exception of the small reef near Umnak, and of the rocks within a short distance of Bogoslova, there was water more than eight hundred fathoms in depth on all sides of the island.

In October, 1883, a violent disturbance burst forth, contemporaneous almost with that at Mount St. Augustine, described in *Science* (vol. iii., No. 54) by Professor Davidson, and resulting, as was believed, in the formation of a new island. The last reports of this, while agreeing materially with Professor Dall's conclusions, show, that, while no new island was formed, Bogoslova was extended; that the old volcano was supplemented by another, which is still active: and that where was relatively great depth of water there is now a land-formation nearly three hundred feet in height.

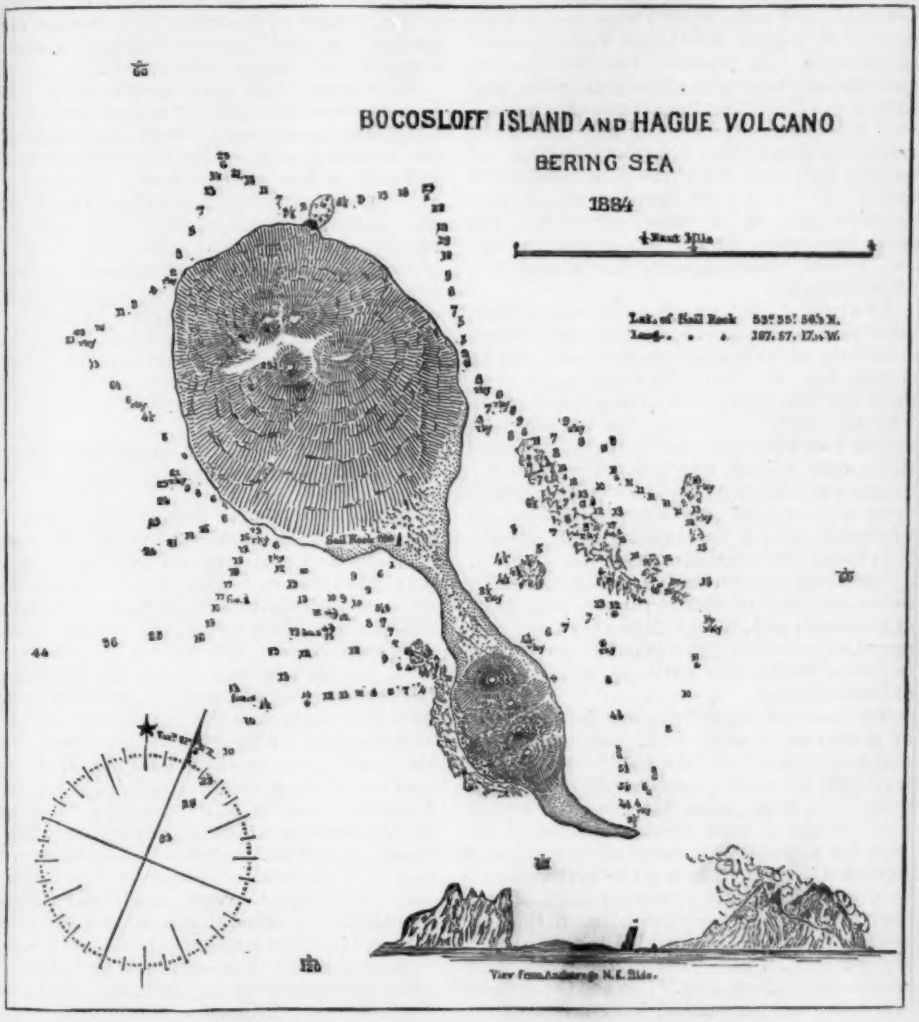
Lieut. Stoney reports that the new volcano was first seen by Capt. Hague in October, 1883, and suggests for it, in lieu of the name 'Grewingk' proposed by Dall, that of its discoverer.

There is no lack of definiteness as to the date of this new formation, all accounts agreeing that the violent eruptions began early in 1883, and culminated about the 16th of October, when "a dark cloud of indescribable appearance covered the sky northward from Unalashka, and hung very near the earth for some time, excluding the light of the sun, and accompanied by a rise of temperature. In about half an hour this cloud collapsed, and covered the earth with dull, gray, cottony ashes of extreme lightness." During this period the volcano of Makushin, on Unalashka, was quiet, though shocks were felt there; and in the subsequent survey, Stoney found that "the dust and ashes which fell in Unalashka were the same as those seen on the sides of the new volcano."

On the 27th of May of this year, Stoney saw, after leaving this last island, the smoke of the new volcano, then distant forty-five miles, and bearing south-west; and by three A.M. of the 28th it was in plain view, the base distinct,

[1] Communicated by the U. S. hydrographic office.

but the crater, save at rare intervals, hidden by masses of black and whitish smoke. What Hague and Dall supposed to be a new island was then seen to be a new formation, connected



with the old island by a low sand-spit. Within its curve a narrow bay, well protected from northerly winds, was sighted; and, running in through thick volumes of sulphurous smoke, the schooner was anchored, amid bubbling water, in thirteen fathoms, with a sand and gravel bottom. This anchorage lay to the northward and eastward, and was supposed to be the best available; but subsequent surveys proved that another roadstead to the southward and westward was better, both in shelter and holding ground.

Three days were occupied in surveying the volcano; a hasty reconnoissance, made immediately after arrival, having satisfied Stoney that with the exception "of the occasional

shaking-up by shocks, and of the persistent odor of the sulphur," the anchorage was a safe one. The first impression of the volcano was its likeness to an immense lime-kiln; though when the intermittent masses of smoke from the crater and from the fissures, which in some cases extended to the water's edge, gave a clearer view, its jagged mouth and sides dispelled the illusion. At intervals the side crevices gave out only faint, pale ribbons of smoke, and then it was found that their edges were covered with incrustations of sulphur and of a white crystalline formation. A thermometer inserted an inch and a half below the crust reached its limit (250° F.) in a few seconds, the air temperature being at the same time 40° F. The crust was warm, though not unbearably so; but a stick placed against the heated rock blazed instantly.

As a rule, vibratory motion of the whole mass could not be discovered; though, with instruments, the explorer believed vibrations could be continuously detected. This statement rests upon the fact, that, when taking observations with the artificial horizon, the mercury was agitated so constantly as to permit accurate sights only at long intervals. Upon one occasion, while climbing the sides of the volcano, there was a most sensible vibration of the whole mass; and at the anchorage many shocks, both single and successive, were felt.

Rumbling sounds, and a dull roar similar to the discharge of distant cannon, were heard at intervals; and, though flames were seen only upon two occasions, yet this is believed to have been due to the little darkness of the season at that latitude.

The mass of the volcano was found "to be of a species of sand rock, with large black rocks scattered about the crust." No traces of lava, and but small quantities of pumice, were found. In some places the sand and cinders were ground to a fine powder, ankle-deep as a rule, but so yielding in places as to prevent an extended survey. The most careful examination revealed no trace of shells, though many of the rocks at the base "looked as if they had been exposed for a long period to the action of the water . . . and some of the rocks under water were still smoking." When the compass was taken ashore, marked local action was so noticeable as to prove the presence of iron.

Near the base of the volcano the water bubbled and broke, as if boiling, but no difference was found in the surface and bottom temperatures; and at the anchorage, where the same ebullition was apparent, there was a difference of one degree only between the same points.

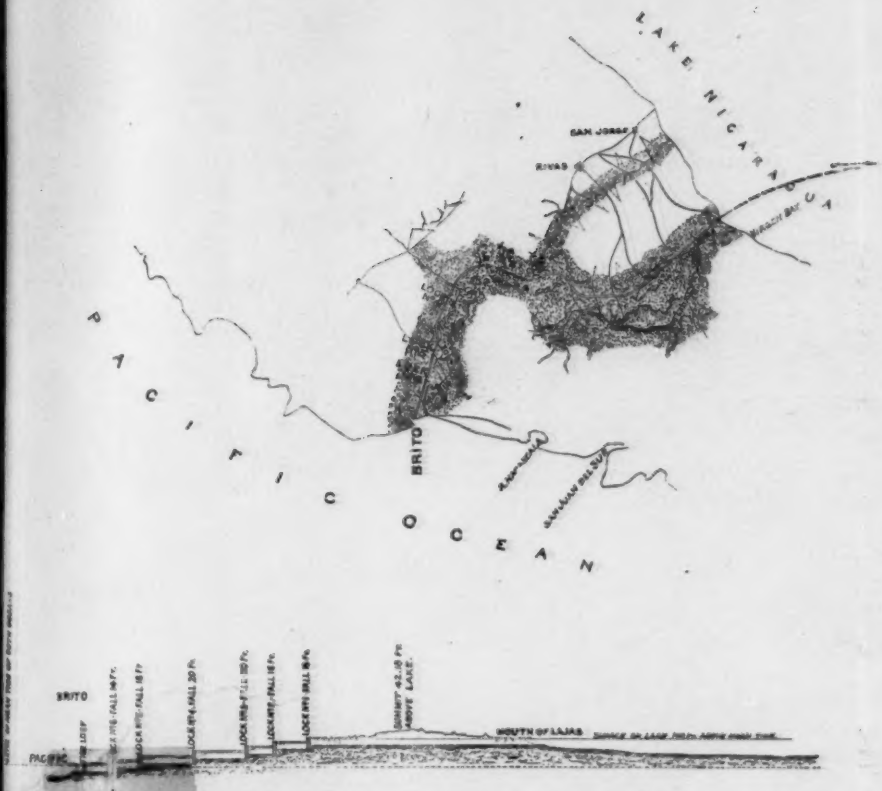
Though one of the party reached the summit of the crater, no estimate of its periphery, depth, and apparent area, could be made. By repeated measurements the altitude of its summit was found to be three hundred and fifty-seven feet. Some discrepancies were found on the printed hydrography of the place; for example, the reef charted as extending from Bogosloff to Umnak does not exist.

Birds were found upon the old volcano in enormous numbers; gulls, shags, and sea-crows being so numerous, that, "when a gun was fired, the heavens would become black with them," and such as flew into the smoke of the belching hill, as many did, immediately perished. The sand-spit on the eastern shore, and the base rocks, were the resting-places for hundreds of sea-lions. No fish could be found, though lines were frequently put over; and, strangely enough, it is recorded, that, three days before the eruption on Augustin Island, all the fish are said to have disappeared from Port Graham.

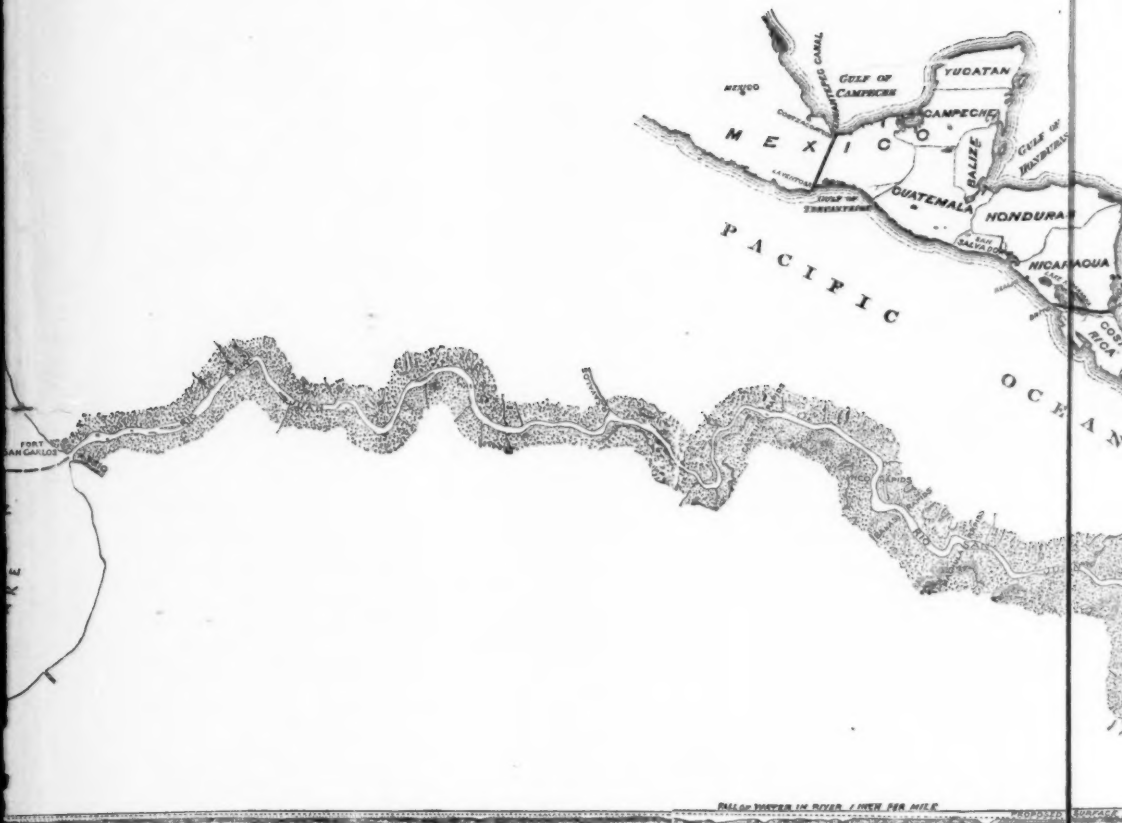
CANAL ROUTES BETWEEN THE ATLANTIC AND THE PACIFIC.

Internal canals, or canals connecting different parts of the same country, are now rarely constructed; and many formerly in use have been dried up, and superseded by railways; while ship-canals are becoming more common and of greater importance than internal canals have ever been. The opening of the Suez canal has brought back to the Mediterranean the commerce of the east. Greece will soon have a canal through the Isthmus of Corinth, with its outlet at the Piraeus of Athens; and the Dutch are constructing a ship-canal to connect Amsterdam directly with the sea. In England a canal is to be built from the ocean to Manchester, which will make that city a seaport town, and transfer to it a large portion of Liverpool's commerce. In France a canal is proposed between the Mediterranean and the Bay of Biscay; and in Massachusetts a canal is cutting across Cape Cod.

Besides the Panama canal, there are two projects for connecting the Atlantic and Pacific Oceans, — the Tehuantepec route, advocated by Capt. Eads, the engineer of the great railway bridge at St. Louis and of the water-way at the mouth of the Mississippi River; and the Nicaragua route, by Capt. Bedford Pim of the British navy, for a long time favorably known to the scientific world. He was the first man who marched from a ship coming

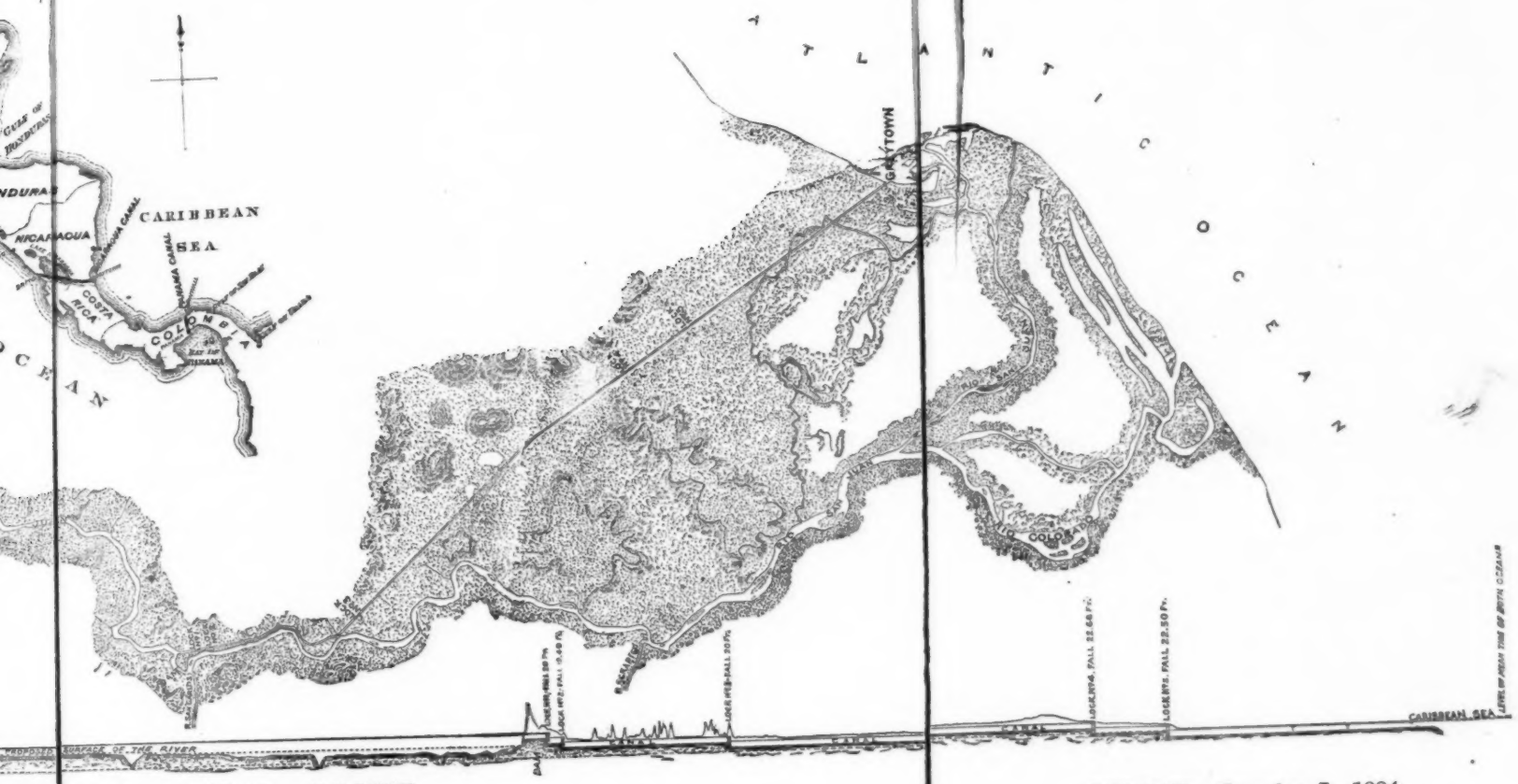


Brito to Greytown, 173.57 miles.
Vertical fifty times greater than horizontal scale.



PLAN AND PROFILE OF THE NICARAGUA INTER-OCEANI

Compiled from various surveys, by A. G. MENOCAL, civil engineer, U.S.N.



OCEANIC CANAL ROUTE.

SCIENCE, *November 7, 1884.*

through Baffin's Bay to the Navigator,—a vessel which had entered the ice through Bering Strait, and saved the crew of the latter from starvation; thus for the first time solving the north-west passage, and proving it impracticable for commerce. Later, he was the first to enter Suez on the locomotive from Cairo, and, with the late Robert Stephenson, made a careful study of the isthmus, and of the hydrographic qualifications of the harbors at Suez and Port Said. Subsequently he spent three seasons, with a large staff at great labor and expense, in making a profile of the Nicaragua route from Greytown, through Lake Nicaragua, to the Pacific Ocean.

Count de Lesseps proposes to make the Panama canal broad enough and deep enough to allow the passage of the largest ships from the Atlantic to the Pacific. Mr. Eads proposes to construct a canal and railway across the Tehuantepec route, and, in cradles adjusted to large cars, to carry the vessels from ocean to ocean over this railway; while Capt. Pim's project is to dig a canal eight feet in depth, to raise the vessels by hydraulic lifts, and float them into a shallow dock on pontoons drawing six feet of water, claiming that in this way a vessel can cross the isthmus as quickly as by a deep-water canal, and that, by clearing the ship's bottom of barnacles during the passage, a further saving of time may be effected.

Capt. Pim objects to the Panama route on the grounds that the difference in the height of the water at Aspinwall and Panama will render it difficult, and without locks impossible, for vessels to enter and leave the canal; that Panama is within the equatorial calm-belt, where the periodical calms continue ten or eleven months in the year (his own vessel, the Herald, was towed 700 miles from the land before reaching a breath of wind), and that on this account it will take a longer time for sailing-vessels to go to San Francisco by the Panama canal than by Cape Horn.

He says, that, when the Panama railway was built, it was expected that large quantities of oil would be shipped over it; but no whaler has ever reached Panama. He estimates that the cost of this route will be not less than $150,000,000, or nearly twice as much as that of the Nicaragua route, the U. S. engineers estimating the cost of the latter at $82,000,000. The proposed route through Nicaragua (see the accompanying chart) is by a canal from Greytown to a dam to be constructed on the San Juan River, from there, by the river, to Lake Nicaragua, across the lake, and thence by a canal to the Pacific Ocean, making a total distance of 173.57 miles. The surface of Lake Nicaragua is 107 feet above the level of the Atlantic, and the height of the land between the lake and the Pacific is 147.7 feet, requiring a cut of 40 feet to bring the canal to the lake-level. This necessitates a series of five locks between the Atlantic and Nicaragua, and seven between the lake and the Pacific. There was formerly an excellent harbor at Greytown, but it was filled up by the silt coming down the river; and at present there are no good ports on either side of the route, though it is believed that they can be constructed at a moderate expense. It is proposed to change the course of the river so as to prevent the silt from coming down, and then to excavate the harbor at Greytown; while at Brito, on the Pacific coast, a harbor can be made by the construction of two breakwaters.

Nicaragua is 600 miles nearer San Francisco than Panama; and, as stated, sailing-vessels from the latter must make a long *détour* in order to obtain the advantage of the monsoons; making a difference of 2,100 miles, or fourteen days, in favor of Nicaragua, though on the return trip the difference is only about 600 miles, or four days. Although tonnage by steamers is increasing, yet at the present time the tonnage of sailing-vessels largely exceeds that of steamers. The tonnage of sailing-vessels in 1877, in the United States, was twice as great as that of steam-vessels, though at the present time it is only one-third more.

The difference in favor of the route from Nicaragua to Japan, China, and the Sandwich Islands, is over 800 miles, while on the return it is only 600 miles, and to India and Australia, 400 miles. It is also stated that vessels can sail in a shorter time from Nicaragua to Valparaiso and Callao, than from Panama, although the distance is considerably greater. The saving for steamers, however, will not be nearly so great, amounting only to the direct distance between the two Pacific termini; that is, about 1,300 miles for the round trip between Panama and San Francisco, or five days in a ten-knot steamer.

The committee appointed by our government in 1877, consisting of Gen. A. A. Humphreys (chief of engineers), Capt. C. P. Patterson (superintendent of the U.S. coast-survey), and Commodore Daniel Ammen, 'after a long, careful, and minute study' of the several surveys of the various routes across the continent, reported unanimously in favor of the Nicaragua route as possessing "greater advantages, and offering fewer difficulties from engineering, commercial and economic points of view, than any

one of the other routes shown to be practicable."

Admiral Ammen of the U.S. navy, in his speech on the Nicaragua route before the American association for the advancement of science at Philadelphia, said that there were 2,000,000 tons of grain produced on the Pacific coast by English-speaking people, which find a market around Cape Horn, mostly in English ports; and that there were vast quantities of timber-lands, extending from Puget Sound to Bering Strait, with the best quality of lumber, which can be shipped through this canal most advantageously. From time to time, a good many estimates of the tonnage that would use the canal have been made, nine of which, obtained by the U.S. commission, range from 3,000,000 to 6,000,000 tons of freight, and give an average of 3,804,000 tons per year. The estimated toll is three dollars per ton, in addition to the port charges and other dues; but the actual expense to the vessel will depend upon the rule adopted for ascertaining the charge, and whether the tonnage is charged upon the actual amount of cargo carried, or on the gross tonnage of the vessel. The latter, which is the method proposed by Mr. de Lesseps, would make the actual cost about six dollars for each ton of merchandise carried.

"The tonnage of the world in 1870 amounted to 17,963,293 tons, and, in 1879, to 20,395,815 tons. These amounts were made up of steam and sail tonnage, as follows: —

Years.	Steam.	Sail.
1870	2,466,498	15,496,795 tons.
1879	4,366,221	16,029,594 "
Gain in 9 years	1,899,723	532,799 tons.

"From this it will be seen, that, while the sailing-tonnage has actually increased, it has not done so at a rate to compare with the increase of the steam-tonnage, which has been facilitated by many causes, prominent among which was the opening of the Suez Canal. Sailing-vessels cannot use this canal to advantage: hence the increased commerce resulting from its construction has called into existence much of the increased steam-tonnage. It is very probable, that, in the event of the opening of a canal by way of Nicaragua, the sailing-tonnage would increase at a remarkably rapid rate, as this route lies in a region which is highly favorable to sailing-vessels."

Gardiner G. Hubbard.

CERTAIN PRINCIPLES OF PRIMITIVE LAW.

A definition of the term 'law,' that will hold good under all circumstances, must be divested of the many theories of its origin, the source of its authority, and its ethical characteristics, which are expressed or implied in customary definitions, and laws must be considered as objective facts. The following definition will perhaps do under all circumstances: *A law is a rule of conduct which organized society endeavors to enforce.*

In civilization, law is theoretically founded on justice; but in savagery, principles of justice have little consideration. There are two fundamental principles at the basis of primitive law: viz., first, controversy should be prevented; second, controversy should be terminated. A third is derivative from them; namely, infraction of law should be punished. These principles enter into primitive law in many curious ways.

It was customary among the tribes of North America for individuals to mark their arrows in order that the stricken game might fall to the man by whose arrow it had been despatched.

A war-party of Sioux surprised a squad of sleeping soldiers, who were all killed at the first volley from the Indians. Their arms, blankets, and other property were untouched, because, the attacking party being large, it could not be decided by whose bullets the soldiers were killed.

It has been widely believed that the practice of placing the property of deceased persons in their graves when they are buried has its origin in religion, and testifies to the universal belief that the dead live again, and will need such articles in their new life. But many tribes of North America who have not yet been long in contact with white men avow, that, there being no owner for the property, its disposition might lead to controversy, and hence it is destroyed. Many examples of this fact have been collected. Ownership to the greater part of property in savagery is communal, some classes of property being owned by the clan, others by the tribe; and for such there is no proper inheritance, as the clan and tribe do not die; but purely personal property is inherited by the grave. It seems probable that such is the origin of the custom of burying various articles with the dead. Subsequently it has religious sanctions thrown about it, as have many social customs.

There is a law, among the tribes of North

America, that superior age gives authority. This law is widely spread, and perhaps universal, and exercises a profound influence in tribal society, as the occasions for its application are multifarious. Like many other of the institutions of tribal society, it is woven into the structure of tribal language. Linguists have recorded as a curious fact, that in these languages there is no single term for 'brother,' but two terms, — one signifying 'elder brother;' and the other, 'younger brother.' They have also found similar facts relating to the term 'sister,' and to some other kinship words; but, so far as I know, they have failed to observe that the law applies to all consanguineal kinship names. All of these titles express relative age between the person speaking and the person addressed. Among savage tribes the age of an individual is not kept. No man knows his own age; but every man, woman, and child in the tribe knows his relative age to every other person in the tribe, — who are older and who are younger than himself, — for, in addressing any other person in the tribe, he must necessarily use a term which implies that the person addressed is older or younger. The law that authority inheres in the elder is a simple and ingenious method of preventing controversy.

The above is the explanation of another curious custom observed among savage tribes; namely, that it is illegal to address a person by his proper name. Kinship terms are used in direct address, proper names in speaking of a third person. It is hardly necessary to state that by this device controversy is prevented.

An interesting form of outlawry exists among some tribes. When a man has frequently involved his clan in controversy with other clans by reason of quarrels or other outrageous conduct, his own may decide no longer to defend him, and will formally announce in tribal council that such person is no longer under their protection. If the person thereafter by his conduct maltreats any member of the tribe, the injured party may do as he will with the offender, and not be held accountable by the kindred of the outlaw.

The few illustrations here given are sufficient, perhaps, to make clear what is meant by the statement that a large class of savage laws are designed to prevent controversy. Many other illustrations might be given, for they are found on every hand.

Three especial methods of terminating controversy are widely spread among the tribes of North America.

When controversy arises in relation to ownership, the property is usually destroyed by the clan or tribal authorities. Thus, if two men dispute in bartering their horses, a third steps in and kills both animals. It seems probable that the destruction of property the ownership of which is in dispute is common to all tribes.

A second method of ending controversy is by the arbitrament of personal conflict. For example: if two persons disagree and come to blows (unless conflict end in the maiming or killing of one of the parties), it is considered a final settlement, and they cannot thereafter appeal to their clans for justice. By conflict a controversy is outlawed. This law seems to be universal.

The third method of terminating controversy is by the establishment of some day of festival — sometimes once a month, but usually once a year — beyond which crimes do not pass. The day of jubilee is a day of forgiveness. The working of this principle might be illustrated in many ways.

We have thus briefly set forth certain principles of primitive law, in order that the subject of marriage law in savage society, which will form the subject of a future paper, may be clearly understood. Law begins in savagery through the endeavor to secure peace, and develops in the highest civilization into the endeavor to establish justice.

J. W. POWELL.

SIR WILLIAM THOMSON'S BALTIMORE LECTURES.

THE title 'Molecular dynamics' does not give an accurate idea of the nature of Sir William Thomson's recent course of lectures at the Johns Hopkins university. The object of the lectures was to consider the possibility of placing the wave-theory of light upon a perfectly tangible physical basis which should be sufficient to account for all the phenomena. The lecturer stated at the outset that he would be occupied more with pointing out difficulties than with removing them. He expressed the conviction that what takes place in the propagation of light — at least through gases, if not through solids and liquids — can be represented in its essential features by supposing a mass of vastly denser matter in the ether, bounded by a perfectly rigid shell; this shell surrounded at a small interval by another perfectly rigid spherical shell; and so on. Each shell is connected with the one outside it by a number of spiral springs: the precise number of the shells is not a vital matter in the theory, and the actual number may be infinite, i.e., the system of shells may constitute a continuous atmosphere to the molecule. The problem of the modes of vibration of this system is essentially the same as that of a system of particles connected by

springs in a straight line. As for the ether itself, it is to be considered as a substance which may not be an elastic solid, but which, so far as the luminiferous vibrations are concerned, moves as if it were an elastic solid. The lecturer carried on the mathematical discussion of these two dynamical problems — the propagation of waves in an elastic solid, and the motion of a system of spring-connected particles in a straight line — side by side, usually devoting the first half of a lecture to one problem, and the remainder to the other.

It is impossible here to give any specific account of the contents of the lectures; it may be stated, however, that many of the cardinal phenomena of light were shown to be explicable by the hypothesis sketched above, but that the phenomenon of double refraction presented apparently insuperable difficulties, as it has done in all previous attempts to explain it. By proper suppositions regarding the elasticity of the springs (in the mechanical 'model' of the phenomenon given above) double refraction would indeed be produced; but its law would be widely different from that actually observed.

The lecturer was conversational in his manner, made almost no use of notes, and was full of enthusiasm for his subject. The audience was composed of professors of physics from eastern and western colleges, scientific men from Washington, and students and instructors of the Johns Hopkins university. The lectures, while not condensed in form, presupposed thorough familiarity with the physical and mathematical theories involved. A verbatim report of them, from stenographic notes, will be issued in a limited edition, by the use of the papyrograph process. At the close of the course, Sir William Thomson was presented by the class with one of Rowland's concave gratings, as a memento of their connection with him.

NORTH-AFRICAN ARCHEOLOGY.

At a meeting of the Academy of natural sciences of Philadelphia, Sept. 25, Dr. Daniel G. Brinton called attention to a collection of flint-chips collected at the station of Ras-et-Oued, near Biban, on the south-eastern coast of Tunis, and presented to the academy by the Marquis de Nadaillac. The specimens consisted of flint-chips, arrow-points, and a semi-lunar shaped implement of small size, which resembles the 'stemmed scrapers' found in America. This form was obtained from lower levels below the surface, and is characteristic in France of the later productions of the stone age, especially of that epoch called by the French archeologists 'the epoch of Robenhausen,' from the locality of that name in Switzerland. Chronologically this is regarded as the first epoch of the appearance of man on the globe, the previous implement-using animals being probably anthropoids. These made use of stone only, not having learned the dressing of bone or horn. This view adds to the interest of the query as to the purpose of these scrapers. That they were an important tool to the primitive man is evident from their wide distribution. They have been found in France, in the Crimea, in India, in America (both North and South), and now we have them from Africa. The strata in which they have been found are of great antiquity.

The archeology of the North-African coast has especial claims to attention, as from there, apparently, a very ancient migration advanced northward, passing in one direction through Spain, and in another by way of Malta, Sicily, and Italy. This migration was apparently contemporary with the appearance of the Elephas africanus in Europe. Another point of interest, connected with North-African archeology, is found in the fact that the only locality in the old world where animal or effigy mounds have been reported is in Algiers, near the forest of Tenrit-el-Sad, south of Miliana. As these peculiar structures are so frequent in the Mississippi valley, the coincidence is worth noting.

Prof. A. Heilprin contended, that while on the hypothesis of evolution, no objection could be raised to an assumption which made an animal intermediate between man and the anthropoid apes sufficiently intelligent to understand the full value and manufacture of stone implements, such as were exhibited, yet, as a matter of fact, paleontological evidence had thus far failed to prove that any such use or manufacture had been made of them, as was claimed. Indeed, no evidence was forthcoming to show that the implements were not the work of man himself, despite the fact that no traces of human remains have been found associated with the fragments. The assumption that the advent of man dates only to a given period of the so-called 'stone age' was considered to be purely gratuitous, and to rest solely on negative evidence. Many archeologists concur in the belief that man's remains may yet be found in deposits of a strictly tertiary age.

THE LIMITATIONS OF SUBMARINE TELEGRAPHY.[1]

The weight of the conductors, says Henry Vivarez in *La lumière électrique*, plays an important part in submarine telegraphy, not merely as a heavy item in the outlay, but as one of the principal factors in laying down the lines, and in taking them up in case of damage. When the conductor is being raised, the grappling-irons which lift it have to resist not merely the vertical component of the weight of the cable, but also the considerable effects resulting from friction against the water. It thus frequently happens, when working at great depths, that the conductor may be exposed to a strain greater than it is able to bear, and we are forced to have recourse to stratagems to bring it to the surface. These artifices consist in the use of two or more ships in raising, which is done as shown in figs. 2 and 3, or, in the most simple cases,

[1] Reproduced in abridged form from the *Electrical review*, and the cuts from *La lumière électrique*.

with the aid of an auxiliary buoy, as in fig. 4. In any event, we see that the difficulties, and of course the cost of raising, must be considerable.

Hence to decrease the weight of the cables would be an important step in advance. If the weight is in general very great, it is because the copper core does not take any part in the strain which the entire cable has to resist. We know, indeed, that copper cannot bear a breaking-strain greater, at most, than 28 kilos per square millimetre. Besides, it would be

FIG. 1.

elongated by such a strain by a very considerable fraction of its initial length; and, if the core were made to take part in any manner whatever in the strain which the entire cable has to support, it would be drawn out beyond its limit of elasticity, and would remain permanently elongated, whilst the substances in which it is enclosed would return to their natural length. It would result, that, being no longer able to find room in a sheath which had become too short, the copper wire would take a sinuous form in its gutta-percha envelope, and would occasion at certain points ruptures, the effect of which would be to decentralize the wire, to perforate the layer of insulating matter, and finally to open out a fault in the cable.

But there exists an alloy (silicium bronze) which can be drawn out into wires having a conductivity equal to that of copper, and a mechanical resistance equal to that of the best iron. The use of this alloy would render it possible to set free the coating of the

FIG. 2.

cables from a part of the strain which it now has to resist, and to diminish, consequently, their dimensions and weight. Wires are now made of this alloy, having a conductivity of from ninety-seven to ninety-nine per cent of the standard, which at 0° C., and with the diameter of a millimetre, have a resistance of 20.57 ohms per kilometre. These wires do not break with a less strain than from 45 to 48 kilos. per square millimetre, and, which is a very precious property, their increase in length at the moment of rupture does not exceed one or one and a half per cent.

Let us consider the deep-sea section of cable of the French company from Paris to New York, — the so-called 'Pouyer-Quertier' cable, constructed and laid in 1879 by Siemens Brothers of London.

The respective weight of each of its component elements is, per nautical mile, copper core, 220 kilos.;

FIG. 3.

gutta-percha, 180 kilos.; hemp, or an equivalent, 80 kilos.; 18 wires of galvanized iron of 2 millimetres in diameter, 880 kilos.; external hemp and composition, 400 kilos.: total, 1,740 kilos. Total diameter, 30 millimetres. Total mechanical strength, 3,000 kilos., the wires of the covering being supposed to be of iron. Weight under water, 450 kilos. It can support its own weight without breaking for a length of from six to seven miles.

The Atlantic presents from north to south, and at about an equal distance from each continent, a sort of longitudinal ridge, in which the depths vary from 300 to 400 metres. This ridge spreads out, in 50° north latitude, into the region which has received the principal wires connecting England and France with the United States. On both coasts there are depressions in which the bottom is at the depth of from 4,000 to 6,000 metres. The one on the east extends from the south point of Ireland to the latitude of the Cape of Good Hope, and its left-hand

FIG. 4.

boundary follows the general outlines of the west coasts of Europe and Africa. The two others, the north-western and the south-western, form two basins, bordering respectively on the United States and the Antilles and South America.

In these depressions soundings have shown certain zones in which the depths exceed 6,000 metres, the principal of which are found to the west of the Cana-

ries, to the south of Newfoundland, between Porto Rico and the Bermudas, and to the right of the Isle of Marten-Vaz.

The great depths of the Pacific are differently distributed. Between Japan and California, between 40° and 50° north latitude, there is the Tuscarora depression, which has depths of from 6,000 to 8,000 metres. Parallel to Japan and the Kuriles there is a depression in which has been found the greatest known depth, — 8,513 metres.

We see, therefore, that any new great submarine line, having to extend into another zone than that which has received the present Atlantic cables, must traverse depressions in which the bottom reaches a maximum depth of 4,000 metres. The possibility of raising a damaged cable would be very problematical under such conditions, and it would become certainly impossible in case of a cable from San Francisco to Japan.

Under these conditions, we are forced to conclude that the use of the present cables limits strikingly the progress of submarine telegraphy, which must remain confined to certain zones of the Atlantic, to inland seas, and to lines along the coasts. But if we consider the daily progress of applied science, and the constantly increasing demand for rapid communication between nations, it is certain that we must shortly undertake the study of new cables intended to traverse the greatest depths of the ocean for long distances. Necessity, therefore, compels us to investigate the new solutions of the problem, which may furnish us with light cables, easy to lay, and possible to repair.

A cable made by Mr. J. Richard is composed as follows: core of silicium bronze equal in weight to that of the 'Pouyer-Quertier' cable, or, per nautical mile, 220 kilos.; gutta-percha, 180 kilos.; layer of hemp, 80 kilos. The sheathing is formed of 28 wires of galvanized iron of 1.25 millimetres in diameter, each covered with hemp, and all twisted into a rope around the dielectric; the wires, 500 kilos.; the hemp covering them, 250 kilos. The weight of the cable is, therefore, 1,230 kilos. in the air, and 320 kilos. in the water. Its diameter is 25 centimetres, and its resistance to fracture, 2,800 kilos., of which the core supports one-half. Under these conditions, the cable can support from eight to nine nautical miles of its length, and can be raised from the greatest depths. The results of this comparative examination are self-evident.

For an equal conductivity and an approximately equal mechanical strength, the new cable is in weight and bulk equal to about two-thirds of the Pouyer-Quertier cable. It would cost about $165 less per mile, and would require, for laying, a ship and engines of less power, and therefore cheaper. The reduced armature will suffice to resist friction and the attacks of animal life in the deep sea; but for the shore ends we must keep to the types generally employed. Such as it is, and although it may undergo modifications in detail from a more complete study and from experience, it merits the attention of competent engineers.

THE AMERICAN PUBLIC HEALTH ASSOCIATION.

THE twelfth annual meeting of this association, held at St. Louis from Oct. 14 to Oct. 17, was one of the most successful in the series. The number of members present was large; and it is a matter of great promise for the association, that state and municipal boards of health were more fully represented than at any previous meeting.

These occasions have a value far beyond the intrinsic merit of the papers presented. The discussions are always instructive, often valuable. The sanitary questions of municipal life vary essentially in the different cities of the Union, and are answered in as many ways; and every public-health officer will find something to learn, as well as instruction to give.

Several threadbare topics, which have occupied the attention of this body for years, have disappeared from the programme, such as vaccination, yellow-fever, and malaria.

The order of exercises, as arranged by the executive committee, included the following subjects: Hygiene of occupations, Hygiene of the habitations of the poor, School hygiene, Adulteration of food, Water-pollution, Disposal of sewage by chemical action or irrigation, The observable effects upon the public health of official sanitary supervision, The work of state and municipal boards of health, Disease-germs, Cremation as a sanitary measure in times of great epidemics, Survey of present sanitary situation in St. Louis.

Nearly forty papers upon these topics were submitted. By far the larger number were of more than average merit, giving rise to interesting and instructive debate. The following-named papers contained more, perhaps, than the others upon the newer subjects in sanitary work.

Dr. Sternberg's paper upon disease-germs, read at the evening meeting of the third day, attracted the largest audience of the convention. This paper, which was illustrated by a collection of remarkably good microphotographs projected upon a screen, was substantially a re-statement of observations already made, and fortified by additional research. His statement that he was still at work upon the study of yellow-fever, by means of an abundant material furnished him from Havana, is a source of much satisfaction, somewhat diminished by the fact that this indefatigable and competent investigator carries on his work at his own expense. How long will the people of this country be willing to accept from the well-appointed laboratories of the old world the researches of Koch, Pasteur, and Klein, — investigations into diseases of as much importance to one side of the Atlantic as to the other, — and still hesitate to properly study the one disease peculiar to our own continent — yellow-fever?

Dr. Sternberg's assertion that he has demonstrated the non-existence of a yellow-fever germ in the blood cannot be strictly accurate. At this day one cannot exclude the possibility of making visible, by some at present unknown methods, organisms not yet recog-

nized. His own belief as to yellow-fever appears to be, that the habitat of the possible germ is in the digestive tract, as in cholera.

Professor Vaughan's paper on poisonous cheese treated a subject that has for a long time been under investigation, with no very satisfactory result. He has not been able to isolate the poison, which appears to be soluble in alcohol, but found it to be constantly associated with a very decided acid reaction of the cheese. In this view of the case, we have, then, a test of easy application in any hand.

Dr. B. F. Davenport, inspector of drugs for the State board of health, lunacy, and charity, of Massachusetts, and milk-inspector of Boston, read a paper descriptive of the work done in his laboratory, which, with the work of the state inspectors and analysts, has produced a very marked improvement in the milk-supply of Massachusetts.

Surgeon C. Smart, U.S.A., in a paper upon water-analysis, present and future, called attention to the necessary limitations of a merely chemical analysis of water. The determination of the amount of organic matter is, after all, not of definite value, unless the living organisms that may furnish it can be shown to be innocuous.

Dr. F. R. Fry of St. Louis presented the results of an examination into the artificial mineral waters of St. Louis, notably soda-water, which appears to be generally made with water from polluted wells. This is the danger that also attends the watering of milk. The loss in nutriment is often of far less consequence than the polluted water of the barnyard or other source used.

A paper upon cremation as a safeguard against epidemics, by Rev. G. A. Beugless of Brooklyn, and another by Hon. G. M. Keating of Memphis, on sanitation by fire, were the occasion for the appointment of a special committee to consider the whole subject of the disposal of the dead.

Three conferences of representatives of twenty state boards of health were held during the same week. At these meetings a representative of the Dominion of Canada, and one from the Province of Ontario, were present. This assembly was one of unusual importance, since, in the absence of an effective national organization, the country must look to these bodies for any concerted action in case of the appearence of cholera in this country.

Dr. Rauch of Illinois brought before the conference a carefully prepared statement of his views upon the value of a proper quarantine, and the claims of the states to a protection at the hands of the national government, and, failing this, the obligation to protect their own borders from invasion by contagious disease. His own experience had taught him that cholera in this country had invariably accompanied the infected person, and the person alone, generally an emigrant, surrounded by all the depressing conditions of his journey. He regarded the disinfection of rags, baggage, etc., as of minor importance. He concluded by urging upon congress the rehabilitation of the National board of health, or the formation of some stronger and more largely representative substitute, with power and funds sufficient to maintain a sanitary quarantine on the seaboard, and official inspection of the lines of travel by river and rail in the interior, and to assist states and municipalities in their efforts to prevent the introduction of disease, or to remove it when introduced.

Dr. Chancellor of Maryland presented his views, differing apparently very widely from those brought forward by Dr. Rauch. He did not accept the contagiousness of cholera; did not believe in the value of quarantine, which was always attended by the danger that a false sense of security was engendered, and other necessary sanitary precautions were neglected.

Dr. Holt, chairman of the Board of health of Louisiana, urged a quarantine in the newer and better sense of the word, — a detention of passengers and ships long enough to secure thorough inspection and disinfection; the shorter the period, the better.

A committee of five, consisting of Drs. Baker of Michigan, Walcott of Massachusetts, Herrick of Louisiana, Rauch of Illinois, and Bryce of Ontario, to whom were referred all the papers read, reported certain recommendations which were adopted by the conference, receiving the votes of all the states except Minnesota; she voting 'no' by reason of insufficient time to consider so important a subject.

The main points of this report are the following: —

That the factors essential to the disease are, —

1°. The importation of the disease by ships more or less directly from its only place of origin, in the delta of the Ganges.

2°. Local unsanitary conditions favorable to the reception and development of the disease.

3°. Persons sick with the disease, or things infected by such sick persons.

In view of the possible and probable introduction of cholera in the coming year, and the constant danger from other communicable diseases at foreign ports, it was the sense of the committee that the national government should maintain a national health service which should establish an effective system of quarantine, the appointment of medical officers at foreign infected ports, the prevention of the landing of immigrants until the danger of the introduction of cholera by them shall have passed.

The inspection and quarantine service originally devised by the National board was approved. It was recommended that congress be urged to appropriate five hundred thousand dollars, to be used, the whole or as much as necessary, in case of cholera, for the purpose of removing the disease and of preventing its spread from state to state. A vigorous prosecution of the work of local preparation, by cleaning foul localities and removing unsanitary conditions in anticipation of disease, was insisted upon. The concluding sentences of the report are, —

"The cause of cholera is contained in the discharges of persons affected by the disease or in things infected by such discharges. Should the disease reach this country, the first case, and after this the first case which reaches any given community, should be strictly isolated. All infective material from these and

from any subsequent cases should be destroyed in such manner as to stamp out the disease."

The conference adjourned, to meet in Washington on the second Tuesday of December.

EUCLID AS A TEXT-BOOK OF GEOMETRY.

Although Euclid has long since been superseded in the schools of this country, the following statistical notes on the extent to which Euclid's 'Elements' are still used in other countries may prove of some interest to the readers of *Science*. The figures are derived from a list of editions of Euclid's 'Elements' and 'Data' up to the year 1879, contained in a new Russian school edition of the 'Elements' by Professor Vâshchenko-Zakhàrchenko.[1] This is a noteworthy work in several other respects. Besides numerous and extensive notes, and additions to the text, designed to render Euclid's treatment of geometry more palatable to modern taste, and to fill up some lacunae in the old work, the author has prefixed to his translation a valuable dissertation on the axioms and postulates and on the so-called non-Euclidean geometry of Bolyai and Lobachèfsky, of which a sufficiently full sketch is presented. That a man so well acquainted with modern investigations of the principles of the science of space as Mr. Vàshchenko-Zakhàrchenko (a bibliography of this subject is also appended to the volume) should prove such an ardent adherent of Euclid, pure and simple, for the schools, is a truly remarkable fact. A closer inspection of his own list of editions of Euclid might have shown him that the modern mind does not tend at all in the direction of a revival of Euclid's system and methods in geometry.

This list has 455 entries, of which 2 belong to the fifteenth, 84 to the sixteenth, 92 to the seventeenth, 118 to the eighteenth, and 159 to the nineteenth century. This enumeration includes reprints. Of really different editions there were, according to the author's count, 80 in the sixteenth, 59 in the seventeenth, 50 in the eighteenth, and 115 in the nineteenth century.

Mr. Vàshchenko-Zakhàrchenko, however, does not pretend that his list is complete: indeed, he has not attempted to present a full and correct bibliography of all editions of Euclid. The titles are given in such an abridged form as to make identification in some cases difficult; and typographical errors abound. No American edition appears in Mr. Zakhàrchenko's list, although several have been published in the United States.[2] Still, for our purpose the list, as it is, will yield some interesting results. We have only to group its data so as to show the distribution of the various editions among different nations and by centuries. This is done in the following table:—

Period.	Greek and Latin.	English.	German.	French.	Italian.	Dutch.	Spanish.	Swedish.	Russian.	Polish.	Danish.	Portuguese.	Modern Greek.	Finnish.	Arabian.	Chinese.	Total.
15th century .	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
16th " . .	60	1	2	4	12	-	2	-	-	-	-	-	-	-	3	-	84
17th " . .	43	3	9	16	10	7	2	-	-	-	-	-	-	-	1	1	92
18th " . .	31	26	17	18	11	5	3	3	3	-	-	1	-	-	-	-	118
1800 to 1839 . .	9	15	21	1	1	-	-	1	2	2	1	-	1	-	2	-	56
1840 to 1879 . .	0	95	1	-	3	-	-	2	-	-	-	-	-	1	-	1	103
Total . . .	145	140	50	39	37	12	7	6	5	2	1	1	1	1	6	2	455

There can be only one interpretation of these figures. They illustrate in a striking way the fact that at present Euclid is used as a text-book in the schools in no country but England.

The English editions constitute thirty-one per cent of the whole number in the list, and fifty-three per cent of those in the four principal living languages (English, French, German, Italian). But this disproportion only appears in its full significance when we take into account the time of publication. Indeed, the table shows that up to 1840 the number of editions in the above-mentioned four languages is almost the same, — viz., 45 in English, 39 in French, 49 in German, 34 in Italian, — while, within the last forty years, 95 English editions have appeared, but only 1 German, 0 French, and 3 Italian editions.

In France the yoke of Euclid was thrown off as early as the end of the last century. The last French school edition of Euclid, according to Mr. Zakhàrchenko's list, was published in 1778. Thus, in France the end of Euclid's reign coincides with the beginning of the epoch of greatest splendor in the history of mathematical research; and, indeed, it is well known that this change is directly due to the influence of that celebrated school of French geometers who gave such lustre to the latter part of the eighteenth century, and won for France her unrivalled supremacy in mathematical science during this period. Legendre's 'Elements' took the place of Euclid's, until he, in his turn, had to yield to more modern influences. And as early as 1814, Delambre and Prony, in their report on Peyrard's critical trilingual edition of the 'Elements' and 'Data,' were justified in speaking of Euclid's method as 'une manière passée de mode,' and of his style as 'aujourd'hui peu connu.'

Italy, Spain, Russia, and other countries, soon followed suit. Everywhere the influence of the French school was felt; and, until the last quarter of a century, Legendre supplanted Euclid, when in many of these countries there arose schools of geometers who independently provided their countries with excellent text-books of their own. In Germany, Euclid held his own longer than anywhere else. But, on the other hand, opposition to the old system is nowhere so universal and uncompromising now; and nowhere has modern geometry found so many enthusiastic disciples.

A. Ziwet.

[1] "The Elements of Euclid, with an explanatory introduction and annotations, by M. E. Vâshchenko-Zakhàrchenko. Kieff, 1880." 15+747 pp.

[2] The library of congress possesses two American reprints of R. Simson's Euclid, published by Desilver of Philadelphia in 1825 and 1834 respectively, and an addition of the first three books of the 'Elements' (Playfair's text), with notes, under the title "The geometry of Euclid: with annotations by Horatio Hubbell, Phila., J. B. Lippincott & Co., 1861."

SHAFT-SINKING BY FREEZING.

THE method of shaft-sinking recently invented by Mr. F. H. Poetsch of Aschersleben, by means of the artificial production of low temperatures, is an illustration of the new and unexpected directions in which chemical and physical processes become of use. In sinking shafts for mining and other engineering purposes, and in the construction of deep foundations, the presence of quicksand has always been dreaded; for it can be penetrated, if at all, only with great difficulty and expense. While the use of compressed air has enabled us to sink shafts and place foundations in water-bearing strata, we are limited to depths not much exceeding one hundred feet by the practical inability of the human system to endure greater air-pressures. Mr. Poetsch has successfully applied to such cases a method of shaft-sinking by freezing, which bids fair to remove all the trouble. He proposes to do away with the pumps and air-compressors, to transform the surrounding liquid soil into a solid wall of ice, and in this way to reduce the problem of shaft-sinking to that of work in hard, dry ground.

A system of tubes is sunk around and within the site of the proposed shaft, and a saline solution such as chloride of calcium, of very low temperature, having for its freezing-point — 40° F., and passed through a Carré ice-machine, is caused to circulate through the system by means of inner tubes until the semi-fluid soil is solidified by congelation. The temperature of the ground has been reduced, in actual work, from 52° F. to 0° F. in twenty days, freezing within a circle of about five feet diameter around each pipe, and producing in the quicksand the solidity of sandstone, with all its properties of stability, and a conchoidal fracture.

The method of putting in place the freezing-pipes varies with the locality. When the quicksand has a slight thickness only, and the shaft is already sunk to the water-level, the pipes are simply forced into the sand with a sand-pump working inside. This was the system actually employed at the Archibald mine, near Schneidlingen, Prussia, where twenty-three pipes nearly eight inches in diameter were sunk through a water-bearing stratum eighteen feet thick, and at the Max mine, near Michalkowitz, Upper Silesia. In other cases a boring-machine is used which puts down four pipes at a time, and is worked by the water-jet system. If the fluid soil lies at no great depth, the holes for the pipes are bored from the surface, and the pipes are so arranged that the shaft can be sunk inside of them; but, when the water-stratum is at a great depth below the surface, a shaft of some three feet greater diameter than the finished shaft is first sunk through the firm ground, so as to permit of the sinking of the pipes through the fluid stratum, and the construction of the final shaft within them.

At the Centrum mine, near Berlin, one hundred and seven feet of quicksand had to be penetrated. Engineers had been baffled for years in their attempts to overcome the difficulties. In thirty-three days, with sixteen pipes, Mr. Poetsch had secured a wall of ice six feet thick around the shaft area, and the shaft is now being excavated and curbed without special difficulty.

A series of bridge-piers is to be sunk by this method near Bucharest, Austria. This last contract has especial interest; as it will afford a test of the seemingly just claim of the inventor, that his plan opens up great possibilities in founding bridge-piers. As opposed to the compressed-air process, the main advantages are in the practical absence of limitation in depth, and the relief of the laborers from the effects of severe air-pressures. The entire plant can be used repeatedly, as the pipes can be withdrawn as soon as the ground thaws out. The cost of an undertaking can also be estimated in advance with reasonable certainty.

A more detailed description of this process is given in the *Engineering news*, June 7, 1884, based on an article from the *Zeitschrift für berg., hutten., und salinenwesen in Preussischen staate*, and in the *Engineering news*, July 5, 1884, with illustrations of the plant used at the Centrum mine.

CHAS. E. GREENE.

AMERICAN ORIENTAL SOCIETY.

THE American oriental society held its autumn meeting at the Johns Hopkins university in Baltimore on Wednesday and Thursday, Oct. 29 and 30. A grammar of the Siamese language was reported as nearly finished by one of the members, Rev. S. C. George. A vocabulary of the Mortlock dialect had been offered to the society for publication by a missionary in the Caroline Islands, and a translation of the Prem Sagar from the original Hindi by the Rev. J. M. Jamieson. The Peking missionary association sent resolutions respecting the eminent Sinologue, Dr. S. W. Williams, the lately deceased president of the Oriental society.

Fourteen papers were presented to the society. The extreme east was represented by a paper on the Korean numerals and alphabet. Mr. Rockhill, an *attaché* of the U. S. embassy to China, presented to the library a Tibetan book of poems by Milaraspa, a Buddhist missionary of the eleventh century; and his paper gave an account of the work, with specimen translations. The president of the society, Professor Whitney of Yale, discussed a group of aorist-forms in Sanscrit. The forms in question are of especial interest, inasmuch as they furnish a good test-case for the general trustworthiness of the Hindu science of grammar, as compared with the most modern treatment of the subject. Professor Bloomfield of Johns Hopkins discussed the position of the Vaitana sutra in the literature of the Atharva-veda, an important text of which, the Kauçika sutra, he is now editing. Several Syriac and Hebrew papers of value were presented; but we must pass them by for want of sufficient space.

In Assyriology, finally, there was an account by Professor Lyon of Harvard, of the last instalment of

the cuneiform inscriptions of western Asia. This contains a great deal of linguistic and historical material; e.g., a list of four hundred and eighty Assyrian verbs so arranged as to show an aquaintance with an *alphabet* on the part of the writer. We find, first, a series of groups of verbs whose first and second consonants are the same; and, secondly, within these groups, they are arranged according to their final consonant. This is the first inscription showing alphabetic order, and the alphabet is substantially the same as the Hebrew. Unfortunately the tablet is not dated. There is also an historical tablet of Nabunaid or Nabonetus, who was king when Cyrus took Babylon. Nabunaid tells how he restored the temple of the sun-god, and states that in renewing the foundations he discovered an old inscribed tablet that had been placed there by Naram-Sin, thirty-two hundred years before his own day, i.e., about 3750 B.C. The interest in archeology, therefore, is itself something very ancient.

TAIT'S LIGHT.

Light. By P. G. Tait. Edinburgh, *Adam and Charles Black*, 1884. 8+276 p. 8°.

This book, uniform with 'Heat' by the same author, possesses in an eminent degree the qualities which render all books from Professor Tait eagerly welcomed by students of physical science. Although written primarily for the use of university students, it contains much which would interest and instruct one who has never pursued a definite course of study in physics, while there is not a little which will demand close attention from even a well-equipped student.

The first chapter gives a brief but perspicuous historical sketch of the discoveries in the science of light, down to the work of Alhazen. This is followed by chapters on the sources of light, and an admirable treatment of the consequences of the rectilinear propagation of light-waves. Chapter vi. treats of the speed of light. Chapters vii. to x. inclusive are devoted to the phenomena of reflection and refraction. Of notable excellence in the last of these, is the discussion of the rainbow and halos.

The eleventh chapter, doubtless, contains most that is novel to the general reader; for in it is an explanation of refractions in a non-homogeneous medium, including as special cases the phenomena of mirage. For the solution of the most interesting problems presented by these frequently recurring phenomena, we are indebted to Professor Tait more than to any other investigator; and probably no other writer could give in such a simple form so clear a presentation of the subject. The last section of this chapter the author devotes to a eulogy on his master, Sir W. R. Hamilton, and an emphatic assertion of the necessity of extended mathematical study for the student of physics. This concluding paragraph is as important as it is characteristic in style, and may well be quoted. It reads as follows: —

> "We have thought it absolutely necessary to point out, even in an elementary work like this, that such a perfectly general method [Hamilton's principle of varying action] has been developed; but the few fragmentary illustrations of it, which alone can be given without the use of higher mathematics, are so inadequate to the proper exhibition of its power, that we do not give them here. We have said enough to show that any one who wishes really to know the science as it now stands must previously prepare himself by properly extended mathematical study. When he is possessed of this indispensable instrument, he may boldly attack the precious stores of knowledge already accumulated. There is, as yet, no admission to any but those possessed of this master-key."

Fluorescence and absorption, with the attendant phenomenon of anomalous dispersion, form the subject-matter of chapter xii., which contains a highly interesting extract from a recent letter by Professor Stokes on the subject of fluorescence. The next chapter introduces the undulatory theory of light; the remainder of the book being a development of its consequences, including, in the final chapter (xvi.), radiation and spectrum analysis. An appendix contains, 1°, Hamilton on theories of light; 2°, Huygens on rays; and, 3°, the well-known and astonishing letter of Laplace to Young, on the undulatory theory. An index closes the volume.

Though the book is, perhaps, the most important acquisition to the literature of its class for a number of years, there is one particular in which we could have looked for something better. The theory of lenses given is the old one, which has hardly been improved since the time of Kepler, and which is repeated in all English elementary works on physics. By it the approximations are so very imperfect that they are next to useless in practice; while, by employing Gauss's improvements in the theory, formulas no more complicated in form, and hardly more difficult in derivation, could be given, which are of the greatest utility. It has long been the practice in German works, written for students no more advanced than those who will be the readers of this work, to give the Gaussian theory; and it is not easy to see why English writers should have been so slow in adopting it.

THE MAMMALS OF THE ADIRONDACKS.

The mammals of the Adirondack region, north-eastern New York. By CLINTON HART MERRIAM, M.D. New York, *Foster pr.*, 1884. 10+316 p. 8°.

FEW recent works on our native animals will be perused with keener interest by the general reader than Dr. Merriam's 'Mammals of the Adirondack region;' it being a popular narrative of the habits of the mammals of the great Adirondack wilderness, and 'in no sense,' as our author states, 'a technical treatise.' Based almost wholly on original observation, in the main the author's own, it differs widely from the ordinary works on such subjects, every page bearing strong evidence of long-continued, intelligently and patiently conducted field-work.

The region under consideration occupies portions of twelve counties, and has an area about one hundred and twenty miles square. It is made up of mountains and short ranges of high hills, which, conforming to no regular axis, constitute irregular groups of isolated peaks, nearly thirty of which attain a height of three thousand feet, while five exceed five thousand. The region is everywhere studded with beautiful lakes, two of which are more than four thousand feet above sea-level. The western border of the area has an altitude of about a thousand feet; the land rises thence eastwardly to its highest part, along the eastern border, where the elevation falls abruptly to the level of Lake George, three hundred and forty-three feet above the sea. The region is mainly covered with evergreen forests, composed very largely of a single genus (Abies) of coniferous trees.

Owing to the elevation and northern position, the fauna of the Adirondacks is distinctly and almost purely 'Canadian.' Snow covers the ground for nearly half the year, with a mid-winter average of over four feet in depth. During this season the temperature often falls to −25° F., and sometimes to −40° F.; while "variations of forty, fifty, and sixty degrees Fahrenheit are by no means uncommon," and a fall of over seventy degrees in fifteen hours has been observed.

With its isolation, its almost unbroken forests, and its peculiar topographic and climatic features, no region of equal extent east of the Rocky Mountains, doubtless, offers so great attractions to the naturalist.

Dr. Merriam, in his 'General introduction,' devotes some sixteen pages to the topographic, climatic, floral, and faunal features of the region, and then treats in detail the forty-six species enumerated, in systematic order. Two of the species (harbor-seal and fox-squirrel) are given as accidental stragglers; and it is presumed that one or two shrews, and two or three bats, are still to be added to the list. The wolverine, moose, and elk are recorded as extirpated, the last moose having been killed about 1861, while the elk and the wolverine have not been seen there for nearly half a century.

Dr. Merriam writes, in the main, tersely and in good taste; although his impatience with popular fallacies leads him here and there to almost undue positiveness of expression, even though his position may be unassailable. His pages are replete with information gathered from personal observation and from trustworthy hunters and guides, and show a familiarity with the region and its natural productions which only long experience could give. Particularly noteworthy is his account of the panther (Felis concolor), which, owing to the bounty placed upon it by the 'state' in 1871, is now approaching extirpation. Contrary to current opinion and the authority of respectable authors, this animal is represented as "one of the most cowardly of beasts, never attacking man unless wounded and cornered." The wolf, common twelve years ago, is now comparatively rare, the special cause of the decrease not being obvious.

Nineteen very interesting and entertaining pages are devoted to the skunk, — apparently a special favorite of our author, — in which a number of popular fallacies are exposed, among them the belief that the bite of the skunk is usually fatal through giving rise to a peculiar kind of hydrophobia, which has been named 'rabies mephitica.' Dr. Merriam claims that a bite from a healthy skunk is in no way dangerous, as he has found by personal experience, but that skunks, like other animals, are subject to rabies, and, when thus afflicted, are of course dangerous.

There are thirty pages which relate to the common Virginia deer, the only existing ungulate of the region, in which the matter of 'spike-horn bucks' very naturally receives special attention. In 1869 a writer in the *American naturalist* stated that he had hunted deer in the Adirondacks for twenty-one years, but not till within the last fourteen years had he begun to hear of spike-horn bucks. "The stories about them multiplied, and they evidently became more and more common from year to year. . . . These spike-horn bucks are now [1869] frequently shot in all that portion

of the Adirondacks south of Raquette Lake." The spike-horn was described as differing greatly from the common antler of the species, it consisting of a single spike, more slender, and about half as long as the antler, projecting forward from the brow, and giving "a considerable advantage to its possessor over the common buck." In consequence of this advantage, the 'spike-horns' were said to be 'gaining upon the common bucks,' with the prospect that in time they might 'entirely supersede them in the Adirondacks.' The descendants of the original spike-horn — 'merely an accidental freak of nature' — are supposed by this writer to have propagated the peculiarity "in a constantly increasing ratio, till they are slowly crowding the antlered deer from the region they inhabit."

Although this view of the case was criticised by subsequent writers in the *Naturalist*, the original account attracted the attention of Mr. Darwin, who cites it, and generalizes from it in his 'Descent of man.' It has since been affirmed by high authorities that the 'spike-bucks' of the Adirondacks are all nothing more than yearling bucks with their first antlers.

Dr. Merriam scouts the idea (and we think with good reason) that the 'spike-bucks' (which have obtained no little celebrity, and been the basis of much speculation with somewhat visionary writers on evolution) are a distinct race of deer, and is able to cite but a single exception to the rule that 'spike-horn bucks are always yearlings,' — that of a maimed, very aged, ill-conditioned animal. This exception he views as an illustration of the tendency in extreme age for certain parts to revert to a condition resembling that of early life, and of the fact that ill-nourished bucks bear stunted and more or less imperfect antlers. All yearlings, however, do not have true spike-horns; and, if the term be made to include all unbranched antlers, Dr. Merriam inclines to the belief that two-year old bucks may sometimes grow them. The myth of the spike-horn, like many other myths in science, will doubtless still live on, with the characteristic persistency of fanciful errors.

Dr. Merriam's observations respecting the bats, the moles, and the shrews, throw much light upon their obscure ways of life, in confinement as well as in a state of nature. His biographies of the rodents are also full of fresh material. Attention may be especially directed to the accounts of the gray and red squirrels, not less for their grace of diction than for their fulness of detail, and vividness of portrayal.

THE MOSSES OF NORTH AMERICA.

Manual of the mosses of North America. By Leo Lesquereux and Thomas P. James. With six plates illustrating the genera. Boston, *S. E. Cassino & Co.*, 1884. 447 p. 8°.

Thanks to our sole surviving bryologist, the venerable Lesquereux, we have at length a comprehensive manual of North-American mosses. In connection, first with Sullivant until his death, and more recently with James, who devoted himself unweariedly to the necessary microscopical investigation up to the very day almost of his passing away, Mr. Lesquereux has for years been more or less actively engaged in this work, and now happily sees its completion. Those who have been attracted to this most interesting family of plants, but have been deterred from their study by the dearth of accessible books upon the subject, will here find their chief wants supplied. It throws open to our younger botanists a broad field, where much can be done, and needs to be done, and where enviable reputations may be won by patient, skilled, and judicious workers.

The history of our mosses begins with Dillenius, who had received about a score of species from John Bartram, *colonus curiosus* of Philadelphia, and from Mitchell and Clayton of Virginia, describing and figuring them in his 'Historia muscorum,' in 1741. Some others of Clayton's collection were described later by Gronovius, but only seven of these species were recognized as from America by Linné, in his works.[1] The first edition of Sullivant's 'Mosses of the United States' (originally published in the first edition of Gray's Manual, in 1848) included 205 species, of which 51 were exclusively American. In the second edition (1856) the number was increased to 402, the American species being 143. In the present work, with a wider range, there are described 883 species, 363 confined to North America, and 21 others found only in tropical America. Of these American species, one-half (180) were detected and described by our own Sullivant, Lesquereux, James, and Austin; the remainder by Europeans; there having been scarcely a bryologist, from Hedwig and Schwaegrichen to the present generation, that has not been concerned with them. A considerable number of these species have been made on scanty material

[1] One of these Linnean species is not referred to in the manual; viz., Phascum caulescens, based upon the 'Sphagnum foliis tenebrius, graminis, pellucidis,' of Dillenius, which is Tetraplodon australis, Sulliv. and Lesq.; to which must now be added the needless synonyme, Tetraplodon caulescens, Lindberg.

from a single locality, and are of questionable validity. They have, however, to be recognized in a work like this, and in the want of positive evidence to exclude them; and it remains for future students to determine their true status.

Late European authorities are here followed in separating the anomalous genera Sphagnum and Andreaea as distinct orders; while in the Bryaceae, or mosses proper, Schimper's arrangement is in general adopted, with an occasional consolidation of his too numerous tribes and genera, — notably in the case of the genus Hypnum, which, under twenty-eight subgenera, is made to include nearly a fourth of all the species. By several artificial and analytical keys the student is aided in referring his plants to their proper tribes and genera, the characters of which, as well as of the species, are given with sufficient fulness and detail. The synonymy and citation of authorities, while not numerous, are such as to be of service to the student capable of benefiting by them. The habitat and range within our limits is given under each species, but not always with sufficient definiteness; and it is rarely that there is any indication that a species is also exotic, except as it may be inferred from the citation of Bruch and Schimper's figures in the 'Bryologia Europaea.' The nomenclature, too often a weak point with bryologists, is, on the whole, to be commended as in conformity with accepted rules, though subject to criticism in some cases; as where the generic names, Ulota, Tetraphis, and Atrichum, are retained in place of the earlier Weissia, Georgia, and Catharinea of Ehrhart. The views of Mueller, Mitten, and Lindberg, when not followed, are in many cases given in the synonymy.

The publishers have made the book attractive by large, clear type and good paper. Many would doubtless have preferred a somewhat smaller type and thinner paper, by which the bulk of the volume might have been reduced at least one-half. Publishers should remember that the convenience of a 'handbook' is inversely as its size. S. W.

GEOLOGY OF SOUTH-EASTERN PENNSYLVANIA.

Thèses présentées à la Faculté des sciences de Lille université de France pour obtenir le grade de docteur ès-sciences naturelles. PAR PERSIFOR FRAZER, A.M. Lille, 1882. [6]+179 p., 4 pl. 4°.

THIS work is based upon the author's labors as a member of the second geological survey of Pennsylvania during the seven years from 1874 to 1881, being essentially a synopsis of his published reports (C^1, C^2, C^3, C^4) on Adams, York, Lancaster, and Chester counties. These counties, with the addition of Delaware and Philadelphia counties, which are geologically but an extension of Chester county, include all that part of Pennsylvania south of the belt of triassic sandstone, stretching from the Delaware to the Susquehanna, and east of South Mountain.

Professor Frazer recognizes, in the rocks of this limited area, representatives of the four principal divisions of geological time, — the cenozoic, mesozoic, paleozoic, and eozoic eras. The tertiary beds, however, are of no commercial or structural importance, being restricted to a few small isolated patches of marl and lignite. The mesozoic or secondary rocks are, of course, the triassic sandstones, shales, and trap, concerning the limits and age of which geologists are generally agreed. With these exceptions, this is essentially a region of crystalline rocks; and the interest of this memoir undoubtedly centres in the chronological disposition of these stratified crystallines made by our author, who evinces an appreciation of the difficulties attending any solution of this vexed problem in citing the singular fact that those sections of the United States which are the seats of the densest population and the oldest civilization are precisely those where the opinions of geologists concerning the age of the rocks present the greatest divergence.

These rocks, and their extension in other states of the Atlantic seaboard, have been the principal battle-ground of American geologists for the last forty years. In all regions the chief difficulties which they present are their structural complexity, and the general absence of organic remains. But to these we have added, in the district in question, a topography affording few reliable outcrops of the rocks. The Susquehanna forms a remarkable natural section of this region, crossing the strike of all the formations between the coal-measures and the fundamental gneiss. But even here the exposures are few and poor, although what is definitely known of the succession of the lower formations in Pennsylvania has been in great part derived from the study of the rocks along this river and the Schuylkill.

Our author regards these crystalline rocks as belonging largely to the older eozoic formations, and accepts Dr. Hunt's definitions of the Laurentian and Huronian systems, referring to the former the porphyritic and hornblendic

gneisses, with their accompanying coarse limestone and graphite; and, to the latter, a large part of the chlorite and mica schists, and serpentine, with associated limestone, steatite, and argillite, and chrome and nickel ores, east of the Susquehanna, and the felsitic, chloritic, epidotic, and quartzose rocks of the South Mountain.

The felsites are said to be distinctly interstratified with the other rocks named, and the theory of their igneous origin is vigorously combated. The position of the Huronian in this region is shown to be clearly above the Laurentian, and below the primal sandstone; but it is also allowed to fill this great gap, to the exclusion of the Montalban system, which Dr. Hunt has recognized here.

The Taconian system is not admitted to the Pennsylvania column; but the quartzite, schists, marble, argillite, and iron-ores claimed by its defenders are referred, as by the first survey, and by Lesley, Dana, etc., to the Cambrian. With the exception of the Scolithus, found in a small part of the so-called primal or Potsdam series, all these rocks are alike unfossiliferous. Lithologically and stratigraphically they present little resemblance to the primal, auroral, and matinal west of the great valley and in New York; and hence the confident reference of these semi-crystalline rocks to the horizons named seems to rest on a very slender basis of facts.

NOTES AND NEWS.

The English astronomers continue their observations of the great red spot on the planet Jupiter with all the enthusiasm of past years; one observer, Mr. Stanley Williams, obtaining, as early as the morning of Sept. 20, a favorable sight of that part of the disk of Jupiter which should be occupied by the red spot. It was still a visible object, although, at the then unfavorable position of the planet, one of extreme difficulty and delicacy. Only a very occasional glimpse of it could be obtained at all, as a faint patch of no particular color or boundary, until after its transit of the central meridian, when the spot was once seen in its entirety, and with a distinct reddish tinge about it. The great hollow in the red south equatorial belt still remains visible, but it appears to have much diminished in plainness. Mr. Williams has also observed three equatorial white spots, one of which is probably identical with a well-known white spot which has been followed for many years. The red spot has also been re-observed by Mr. Denning.

— At the October meeting of the Natural science association of Staten Island, Mr. Davis exhibited a specimen of one of our green grasshoppers, Conocephalus dissimilis, which he had found without any head, and stridulating while perched upon a blade of grass. When touched by the finger, the insect did not close its wings tightly, as usual, but let them remain far apart. It had evidently not been long decapitated; for, when captured, the muscles in the thorax had their normal appearance. But gradually the tissues dried, and on the third day of its captivity it died without having stridulated again, though every means thought of was employed to induce it.

— Dr. David Gill, her majesty's astronomer at the Cape of Good Hope, will contribute the article on parallax for the forthcoming volume (xviii.) of the ninth edition of the Encyclopaedia Britannica.

— Dr. E. B. Tylor, in an address to the anthropological society of Washington a few weeks ago, in which he narrated some of his experiences among the Mohaves and Zuñis last summer, said the Mohave has the same abhorrence of parting with a lock of his hair that is shown by an Italian or a Spaniard. The Zuñi uses the same sound-producing piece of wood to warn the women away from certain rites attending the admission of youths to the privileges of manhood as is used for a like purpose both in Africa and Australia. The latter consists of a piece of wood attached to a thong, and well known in England as a 'bull-roar,' from the character of the noise it makes when whirled rapidly. The use of bark skirts by the Zuñi women, who now wear a part of them under their joined red handkerchief robes, is paralleled by that of the Australian females. The Zuñis wore these originally in two parts, — one in front, and the other at the back, — forming, when both in place, a complete covering for the lower part of the body. Now that cotton-cloth is procurable, they make a skirt of bright-colored handkerchiefs sewed together, and wear this outside the bark garment, only the rear half or bustle of which they wear. The Australian women preserve the ancient custom by putting on bark skirts on festival occasions. Both customs show a tendency to survival, and a corresponding mode of perpetuating an ancient usage.

— A correspondent of the *Science monthly* writes that for the last year he has been engaged in the herring-fishery on the Kintyre coast, and has often been surprised during the night to hear a strange chirping-sound, like the far-away disconsolate 'chirp' of some small dying bird. "It was something in the air, and always portended southerly winds and foul weather, and was known everywhere as the 'Cheepach,'" was all the explanation that his mates had to offer. It is most frequently heard from the beginning of August till the end of November, and is never heard before sunset or after sunrise, but always during the darkness of night. It is never heard ashore, but often enough within two or three hundred yards of it. It is generally heard whilst sailing, but sometimes, though rarely, while lying at anchor. It is always accompanied by a dampness in the atmosphere, though never with rain, so far as he remembers. The sound is so very like the chirp of a bird that superstitious fishermen attribute it to the ghosts of little birds that have blown to sea and drowned.

— Professor James Hall has been elected member of the French academy in the place of the late Dr. J. Lawrence Smith.

— The experiments on the relative efficiency of different illuminants for lighthouse purposes, which are being carried out in England by the Trinity brethren, have in some respects been completed; and they support the conclusions previously arrived at, in that there seems to be little difference between gas and paraffine-oil for all practical purposes, except that the gaslight is slightly superior in fine weather, but then the electric light has proved vastly better than either. The crucial test of the latter, however, is in hazy weather; and it is stated, that, in some of the observations made when the weather was rather thick, this light did not hold its own against the other illuminants. Important tests will be made this autumn, when hazy weather, and a greater variety in the conditions of the atmosphere, may be expected.

— A well-equipped expedition to East Africa will be undertaken by Dr. Dominik von Hardeggar in the autumn. The first object of the expedition will be to explore the stretch of country between Sela and Harar, then that town itself and its neighborhood. Lastly, if the circumstances are favorable, it will penetrate the land of the Somali to Ogaden, or go through to Schoa. The geographical and ethnographical studies of the expedition will be undertaken by Professor Paulitschke; the geological and zoölogical, by Dr. von Hardeggar himself. A physician and assistant naturalist will accompany the party.

— The university of Freiburg, in Saxony, is to have an institute of zoölogy, Professor Weismann having made it a condition of his remaining there.

— The seventh general congress of German analytical chemists was held this year at Munich on the 9th of August, and the work of the honorary committee continued. The resolutions passed mostly referred to the restrictions of the German laws.

— At a recent meeting of the Physiological society of Berlin, Professor Kronecker spoke of a series of precautionary measures to be observed in cases of saving life by an infusion of common salt solution. He first described how animals, after severe loss of blood, recovered in the best and most rapid manner by introducing into their blood-channels a like quantity of common salt solution. In the case of infusions of albuminous solutions, of serum sanguinis, and even of the blood of another individual of the same species deprived of its fibrine, there was, according to direct measurements, an invariable destruction of blood-corpuscles. With infusions of common salt solution, on the other hand, blood-corpuscles were seen to increase somewhat rapidly. Professor Kronecker then proceeded more particularly to lay down precautionary rules to be observed in applying this agency to man. In the first place, the composition of the solution must be such as was most compatible with the human organism. It would appear that a solution of 0.73 % exercised the least irritation on the human body, and was therefore the most appropriate for infusions designed to save life. The addition of the carbonate of an alkali, recommended by some, had an injurious effect. Of great importance were the velocity and pressure with which the infusion was injected: both ought to correspond with the velocity and pressure in the vein into which the solution entered. The common salt solution should, further, be disinfected beforehand by boiling, and the air which penetrated into the reservoir while it was being emptied must be filtered by means of a wadding stopper. The injurious effect of too strong pressure was illustrated by a comparative experiment on two rabbits.

— The reduction in letter-postage from three to two cents commenced on Oct. 1, 1883. It is interesting to note the effects of this reduction on the postal business of the country as deduced from the returns for the year ending June 31, 1884. During the first three months of the year the three-cent rate was in effect, and the sale of stamps was much reduced in anticipation of the reduced rate. The increase in the sale of ordinary postage-stamps for the five years ended June 31, 1883, was 10.1 %; for the year 1883 the increase was 8.6 %. It is probable, that, owing to the general stagnation in business industries, the increase would have been less than 8 % in 1884 but for the reduction of postage. There was, however, an actual increase of 21 % in the number of 'ordinary postage-stamps' sold, or from 1,202,743,000 to 1,459,768,000, — an increase of 12.4 % over the year 1883, and of 11 % over the average increase for five years. The revenue from the sale of these stamps was $30,307,000 in 1883, $29,077,444 in 1884, — a diminution of $1,230,000, or 4 %. The issue of postal-cards has heretofore increased more rapidly than that of letters, or at the rate of 13.7 % a year on the average for the five years mentioned. During the last year the number diminished 4.4 %, or from 379,000,000 to 362,000,000. In the natural growth of the business, the postal revenue for the next year will probably be greater under the low rate than it has ever been under the high rate.

— Mr. Maxim, the electrician, has invented a machine-gun by which the energy of the recoil from one discharge is employed to load and fire the next round. The rate of firing is controlled by a lever; and, when the gun is once adjusted to a certain desired speed, it goes on firing at that rate until all the ammunition in the magazine is exhausted, whether the man in charge be killed or not. The maximum rate of firing, when the bullets have an initial velocity of twelve hundred feet per second, is six hundred rounds per minute.

— The U. S. signal-service is about to undertake the publication of a general bibliography of meteorology and allied topics (such as earthquakes, terrestrial magnetism, and meteors), and requests from the writers of all countries a complete list of their contributions to the literature of these subjects, including the titles of all separate works, papers, and published observations. The number of titles already on hand is about thirty-five thousand. Especial attention is invited to the importance of full titles,

with details of size, and place and date of publication. References to periodicals should be on this pattern:—

"Quetelet, Lambert Adolphe Jacques,
Sur les orages du mois d'Avril, 1865.
Bruxelles, Acad. Sci. Bull., XIX., 1865, 535-537."

Correspondence should be addressed to the chief signal-officer U. S. army, Washington.

— When the physical studies of the Gulf of Mexico and the Caribbean Sea, now prosecuted by the U. S. coast-survey, are brought to an end, and when our knowledge of the natural history of these waters is sufficiently increased, we shall hope to see a monographic description of them, after the pattern of Ackermann's admirable 'Beiträge zur physischen geographie der Ostsee' (Hamburg, Meissner, 1883). The arrangement of subjects is logical and systematic, and lacks but one chapter of being complete, for geological structure alone is not discussed. The first division of the book considers the form of the shores and bottom, under the heading of morphology, illustrated by bathymetric charts of fine execution; then, omitting the origin of this form, recent geological action along the shores, and the evidences of secular elevation and depression, are discussed. The physical relations of the sea are described under currents, winds and their effects, and the distribution of temperature; and the chapter on biology opens with a general discussion of the causes that influence the occurrence of marine life, followed by an account of the horizontal and vertical distribution of the fauna and flora, and concluding with the effect of the Baltic on the habitat of certain birds. The inward and outward flowing currents at the wider entrance to the sea are described in detail, and the tide is traced till it disappears with a height of only one centimetre at Memel.

— The geographical society at Halle has published a valuable local bibliography of physical and historical writings ('Die landeskundliche litteratur für Nordthüringen, den Harz,' etc., Halle, 1883), covering 170 pages, clearly arranged on a well-considered plan. It begins with natural-history topics (such as geology, hydrology, climate, fauna and flora), next taking questions that refer to population (such as anthropology, statistics, economics, and folk-lore), and ending with papers of special or historical interest; all of this being arranged, first for larger, and then for smaller, geographic areas. Maps of all kinds are included in the lists, and a good index to the various subdivisions allows easy reference to any subject or place.

— Scudder's 'History of the United States' (Philadelphia, J. H. Butter) belongs to the class of manuals which includes the histories by S. Eliot, T. W. Higginson, A. Gilman, and others; but our limits will not permit us to point out how it differs from them. Its typography is attractive; and it is a marvel that so many maps, portraits, and other engravings, can be given in a volume which is sold at so low a price. Among some of the novel illustrations may be named a map of the physical features of the United States, not entirely satisfactory; a map of the discoveries on the Atlantic seaboard in the fifteenth century; the progress of population westward in the United States; the sectional weather divisions employed by the U. S. signal-service; the standard-time belts; and a very large number of diagram-maps, most of which are admirable, inserted in the text to explain the wars, battles, progress of civilization, etc. The text is clear, readable, and concise.

— The fifteenth report of the Massachusetts bureau of statistics and labor, by Carroll D. Wright, contains an interesting paper on the condition of the working-girls in Boston; and this is followed by an elaborate study of the comparative wages, prices, and cost of living, in Massachusetts and Great Britain in the period between 1860 and 1883. As to wages, Mr. Wright's result is as follows: that the general average weekly wage of the employees in the industries considered in Massachusetts was 77 + % higher than the general average weekly wage of the employees in the industries considered in Great Britain. As to cost of living, it appears, that, on any basis of yearly expenditure, the prices of articles entering into the cost of living were, on the average, 17.29% higher in Massachusetts in 1883 than in Great Britain; that, of this figure, 11.49% was due to higher rents in Massachusetts, leaving 5.80% as indicative of the higher cost of living in Massachusetts as compared with Great Britain, as regards the remaining elements of expense.

— The American academy of medicine held its annual convention in Baltimore, Oct. 28-29, with Dr. Benjamin Lee of Philadelphia as president. None but medical men who have had a liberal collegiate education are eligible for membership in this association, which, among other things, endeavors to promote reforms and improvements in medical education.

— The Association for the advancement of women also held its annual meeting in Baltimore, Oct. 29, 30, and 31, under the presiding guidance of Mrs. Julia Ward Howe.

— The excellent 'Monthly reference-lists,' which are printed by Mr. W. E. Foster of the Providence public library, should be watched by scientific men as well as by literary readers. The August number (vol. iv. No. 8) contains a handy index to articles on earthquakes, theories and observations, which was suggested by the shock of Aug. 10, 1884. In judging of the list of memoirs and articles which are cited, the reader should remember that it is prepared for popular reading, and not as an index for the seismologist, or even for the physicist. The second part of the same number is devoted to the early English explorations of America.

— The portrait accompanying our account of Sir William Thomson was engraved from a photograph taken in Canada. Sir William has since sat for a photograph in Baltimore, copies of which can be had on application to Cummins, photographer, 7 North Charles Street, Baltimore.

— Ensign E. E. Hayden of the U. S. navy has been ordered to duty at the Harvard observatory.